NATIONAL MUSEUM OF VICTORIA

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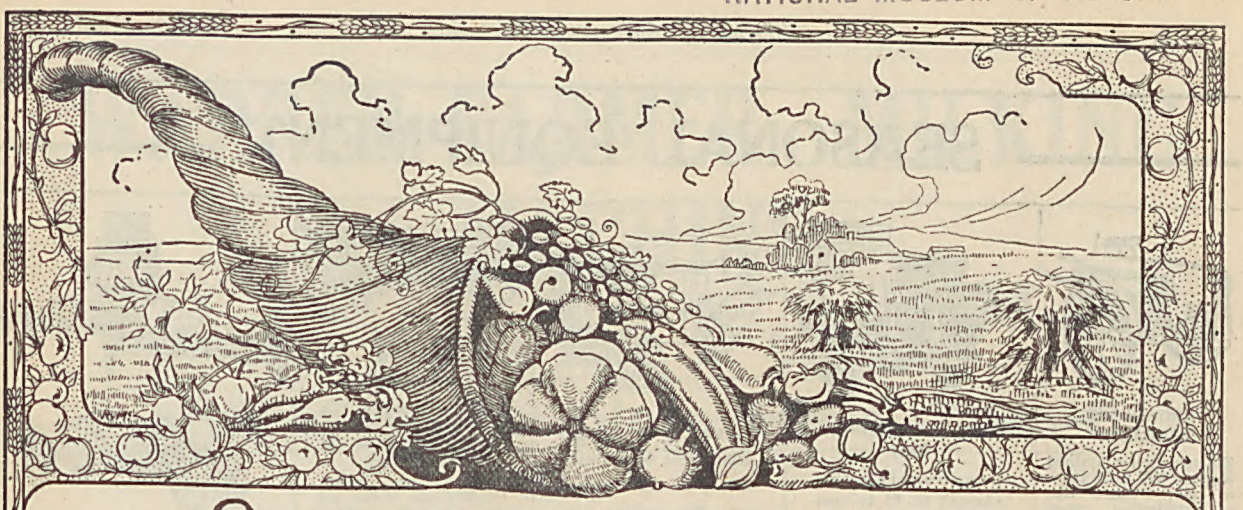

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Issued under the direction of the Hon. E. J. Hogan, M.L.A., Minister of Agriculture.

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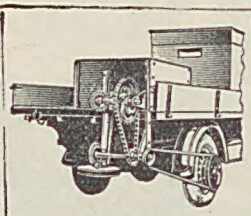

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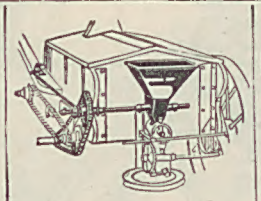

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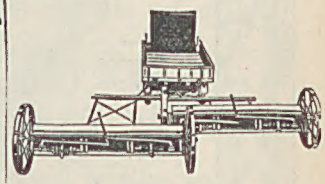

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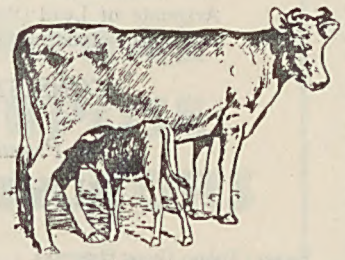

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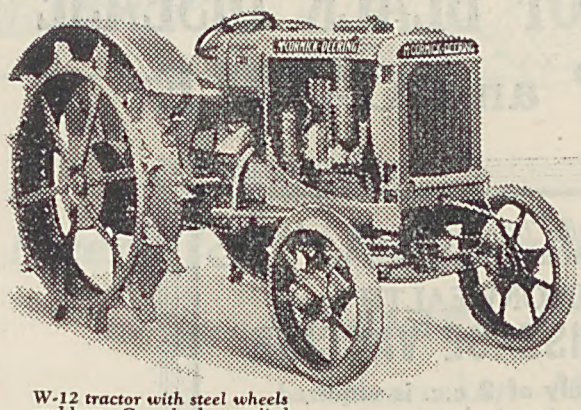

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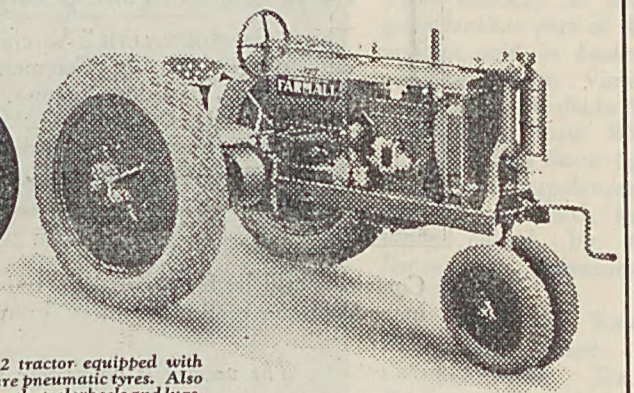

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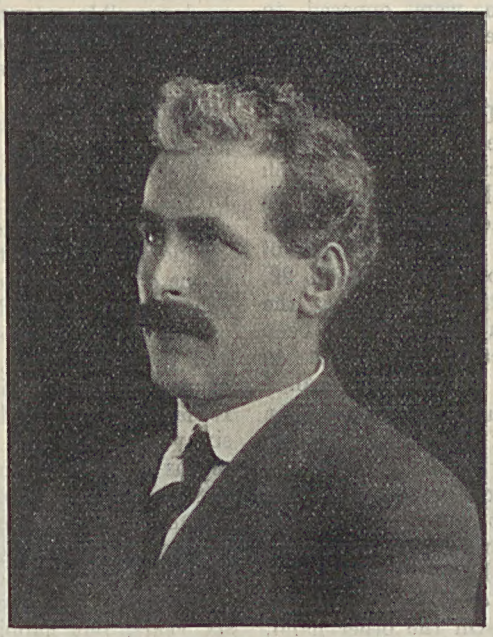
The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

Need for Organized Marketing of Primary Products

Referendum—March 6th

By The Hon. E. J. Hogan, Minister of Agriculture

FOR 36 years the manufacturers and wage earners of the Commonwealth have been protected from the competition of cheap labour countries by means of protective tariffs, the Arbitration Court and Wages Board awards. That has become the accepted fiscal and industrial policy of Australia. This policy, however, did not apply to the primary industries which had to sell that proportion of their produce which was exported, at London parity prices, while the remainder of those products was sold in Australia at London parity, less the cost of overseas freight and selling charges. This was called export parity.



The Hon. E. J. Hogan, M.L.A.

The Dried Fruits Industry.

A few years after the war the Australian dried fruits industry was in grave danger. Extensive additions to the area planted with vines by soldier settlers in Victoria, South Australia, and New South Wales had greatly increased the production of sultanas, currants and raisins in Australia while, at the the same time, the London market was being glutted with dried fruits from Greece, Smyrna, California and Spain.

Dried fruits legislation to ensure for the dried fruits industry a better price for that part of their product sold in Australia was passed in Victoria and South Australia in 1924 and in New South Wales in 1927. This State legislation was supplemented by Commonwealth legislation passed by the Bruce-Page Government in 1928.

In 1933, the Federal Parliament passed the Commonwealth Dairy Produce Act, which, in conjunction with Acts passed by several of the State Parliaments, enabled the dairying industry to stabilize the price for butter and cheese sold

in Australia irrespective of price fluctuations on the London market.

By these laws, the dried fruits growers and the dairy farmers secured a measure of protection and a fair Australian price for that portion of their produce sold within the Commonwealth which placed them in the same relative position as the manufacturers and their employees in secondary industries. This was accomplished by providing that each packer of dried fruits and each manufacturer of butter and cheese should export a fair quota of his produce and sell it at the overseas price while allowing him to sell the remainder in Australia at a price based on Australian costs of production. This ensured to each producer a fair share of the protected Australian market.

The legislative machinery by which this was achieved consisted of State Acts which permitted a proportion of the dried fruits, butter, and cheese being sold within the State, and the Federal Act which permitted interstate trade in those products only if the manufacturer had complied with the State Acts. Both of these provisions were fair and equitable. The Federal marketing legislation did not encroach on the powers of the State, but merely supplemented them and made the State legislation effective.

In 1935, merchants who were opposed to organized marketing invoked the High Court in an endeavour to defeat this legislation, but that Court decided that the Dried Fruits Act was constitutional. The merchants who were opposed to organized marketing then appealed to the Privy Council in England, which reversed the decision of the Australian High Court, and it is to remedy the calamitous position that has thus been created that the people of Australia are being asked to amend Section 92, of the Commonwealth Constitution—so that the marketing legislation which has already been passed by the Commonwealth Parliament to supplement State laws will be constitutional.

The proposed constitutional amendment provides that Section 92 of the Commonwealth Constitution shall not apply to laws passed by the Federal Parliament with respect to marketing. Approval of this amendment of the Constitution by the electors will not increase the powers of the Commonwealth beyond those it was believed to possess prior to the recent decision of the Privy Council in the James case. On the other hand, failure to approve of the amendment will mean the breaking down of organized marketing in Australia and a return to the deplorable conditions that existed when the prices of dried fruits and butter in Australia were determined, not by Australian costs of production, but by the prices at which cheap labour countries situated comparatively close to Britain could dump their surplus dried fruits and butter on the London market.

The Dairying Industry.

When the Dairy Products legislation was passed in 1933 by both State and Federal Parliaments, the dairying industry gave a definite assurance that there would be no exploitation of the consumers and that the requirements of Australia would be fully met. That this assurance has been observed is proved by the fact that in October, 1935, the industry continued to supply Australian consumers at the existing price of 140s. per cwt. irrespective of the fact that export parity value had increased, and was then in excess of this figure. That the industry has not taken undue advantage of the benefits it was given, is demonstrated by the fact that the average equalization price for butter for the year ending 30th June, 1936, was 120s. 11d. per cwt., which permitted a reasonable butter-fat payment to dairy farmers of approximately 13d. per lb. as against the export parity price for the same period of 105s. 1d. per cwt., which would have made possible a butter-fat price of only 11d. per lb. This latter unremunerative price would have been the maximum price for all butter-fat produced in Australia but for the operation of the Equalization system under the State and Federal legislation.

A collapse in prices and consequent serious loss to the producers would follow a breaking-down of this system of orderly marketing, consequently, the decision the electors will make on March 6th, is one of the most momentous they have yet been called upon to decide. The prosperity not only of primary producers, but also of manufacturers and their employees, and of the community as a whole, will be materially affected by the decision. It has been amply demonstrated during the past six years that low prices for primary produce means decreased national income, decreased purchasing power of the people in respect of manufactured products, commercial and business stagnation, increased taxation, unemployment, and a severe blow to the whole community. We experienced all these calamities during the last six years, but happily conditions recently have been improved by the increase in the price of our primary products. The breaking-down of our system of orderly marketing and the consequent losses accruing to primary producers, would bring

back the worries of the depression and the cares and sorrows that are still fresh in the minds of our people.

It is well that we should remember that, notwithstanding the fact that the prices primary producers were receiving for their produce fell by as much as 60 per cent., and their operations were being carried on at a loss, the farmers of Australia did not cease or curtail production during the depression. On the contrary, they put forth extra efforts to increase the volume of their output in an attempt to maintain the Commonwealth's rapidly decreasing national income by maintaining our exports of primary products. It was due mainly to their sacrifices that Australia's credit overseas was preserved. On the other hand, manufacturers in secondary industries, few of whom export any part of their product, minimized the losses they would have sustained through the fall in prices by curtailing, or even ceasing production, thus increasing unemployment, and accentuating the severity of the depression.

In common justice, and as some recognition of the heroic services and sacrifices of Australian agriculturists during the years of the depresssion, the electors of Australia should give to the Commonwealth Parliament power to pass legislation which will ensure more remunerative returns to the producer, and minimize the risks of a recurrence of the depression.

Summarized, the reasons for a "Yes" vote are :—

(1) That it is not proposed to give any new power to the Federal Parliament.

(2) That the amendment is necessary to maintain the constitutionality of existing marketing legislation.

(3) That orderly marketing, after being tried out for several years has, by its proved equity, earned the general approval of all intelligent and fair-minded people.

(4) That the proposed amendment of the Constitution is the only practical means of giving to the farmer somewhat similar protection to that already given to manufacturers and wage-earners in secondary industries.

(5) That the agricultural industry is justly entitled to a fair price for that portion of its produce consumed in Australia.

(6) That Australia cannot prosper unless her primary industries are prospering.

(7) That, unless a fair price is paid for agricultural products used in Australia, the agricultural industry cannot survive, but it can, and will, collapse.

(8) If the agricultural industry collapses, everyone engaged in it, and every one depending on it directly or indirectly, will suffer, and the people will again experience the troubles, worries, and deprivations experienced in 1930 and 1931, and which were mainly caused by the calamitous fall in the price of our primary products.

Let us then all resolve to vote "Yes" on 6th March, and restore prosperity to our country and benefit all sections of the people.

E. J. Hogan

Minister of Agriculture.

LEMONS possess excellent keeping qualities, but if uncongenial harvesting or storage conditions prevail, premature deterioration sets in. The greatest care, therefore, should be observed in harvesting the fruit without damaging the delicate oil cells in the peel. At this stage they are so crisp and easily ruptured that the slightest scratch may prove fatal. Special attention to the hands of pickers, by clipping finger nails closely or wearing soft woollen gloves, is recommended and will amply repay the little extra trouble involved.

Each lemon should be cut or pulled from the tree with about an inch of stalk attached, and this piece of stalk removed with a second cut before placing the lemon in the box, leaving the "button" with as short a piece of the stem as possible. This method of harvesting is specially recommended. One badly clipped lemon will account for untold injury and damage to other lemons with which it may come in contact during further operations; further, for the same reason, the fruit should not be tipped from one box to another.

When lemons are required for storage they should be harvested (irrespective of colour) as soon as they reach a diameter of 2⅜ inches. To do this efficiently, each picker should carry a measuring ring in order to keep as near to the size as possible. Of course, all lemons smaller than the size specified, if tree ripe, should be harvested also.

If the trees are gone over, say every four or five weeks, the large lemons which usually affect account sales will be reduced, and the more profitable counts, ranging from 180 to 225, will predominate.

Grading and Sweating.

Quality grading should be a specialized operation in marketing lemons, as indeed with all other citrus fruit. Green lemons and those commencing to turn colour will keep longer than the yellow or tree ripened fruit and therefore should be sorted out and kept for storage purposes. The large, rough, thick skinned, or corrugated lemons should be sorted for factory use, and the yellow or tree ripened fruit for immediate market purposes.

To permit evaporation of surplus moisture, the fruit should be sweated by stacking in a cool, well-ventilated shed, for a period ranging from five to ten days, according to climatic conditions. This will toughen and strengthen the rind, and enhance keeping qualities by retarding the entry of blue mould, &c.

The green lemons for storage purposes should then be wrapped in sulphite tissue wrapping paper (8-in. x 8-in. is a good size) and packed in large trays or shallow cases and stacked in such a manner that free circulation of air is permitted around and between every tray. To keep the fruit in good condition, the air must be fresh and cool, say 50 to 60°F., and not too dry, otherwise the rinds will become tough and dry. A

relatively high humidity (approximately 90 per cent.) should be maintained, particularly as dry weather approaches. A simple method of raising the humidity is to plunge a piece of hot iron into a bucket of water as the occasion arises.

The yellow or tree ripened fruit can now be put through the grading machine, and sized and packed according to the sizes and counts shown on the packing chart, eliminating at the same time any frosted or mouldy fruit. The large and other lemons suitable for factory purposes also can be gone over to remove any mouldy specimens which might have developed, and the fruit despatched in the ordinary way.

If close attention is given to the sweating of lemons, much will be done to eliminate waste due to moulds developing in transit. In addition, a good pack of lemons cannot be maintained unless the fruit has been properly sweated, as this helps in a very large measure to reduce shrinkage problems during transportation.

Nailing Down.

When packed, lemons should be at least one inch above the top of the case before the lid is nailed on, otherwise the package will become slack before it reaches its destination.

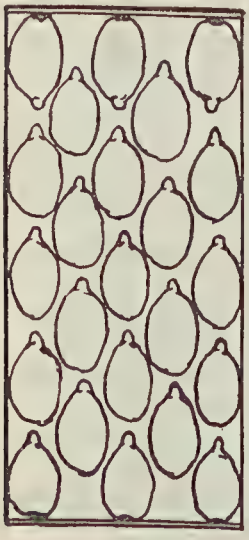
Lemons should never be "nailed down" on a hard or uneven floor. A special press for the purpose should be used. Failing this, a batten placed beneath each end of the case makes a very good substitute.

PACKING CHART FOR LEMONS IN THE "DUMP" BUSHEL CASE.

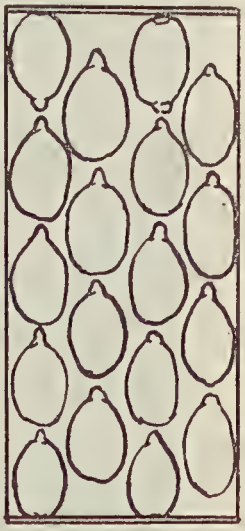
(18 inches x $8\frac{2}{3}$ inches x $14\frac{1}{4}$ inches—inside measurements).

Approximate Size.	Pack.	Layer.	Layers.	Total.	Remarks.
$1\frac{3}{4}$"	3–3	6 x 5	10	330	Small
	3–3	5 x 5	9	270	Large
	3–2	6 x 6	9	270	„
2"	3–2	6 x 5	9	248	Small to medium
	3–2	5 x 5	9	225	Medium to large
$2\frac{1}{4}$"	3–2	5 x 4	9	203	Small. Pack more loosely than usual
	3–2	4 x 4	9	180	Medium. Pack more loosely than usual
	3–2	5 x 4	8	180	Medium. Pack more tightly than usual
	3–2	4 x 4	8	160	Large
$2\frac{1}{2}$"	2–2	6 x 5	7	154	Small
	2–2	5 x 5	7	140	Medium
	2–2	5 x 4	7	126	Large
$2\frac{3}{4}$"	2–2	4 x 4	7	112	Small to medium
	2–2	4 x 3	7	98	Medium to large
3"	2–2	3 x 3	7	84	Small to large
	2–2	4 x 3	6	84	„ „

Special Note re $2\frac{1}{4}$ inch Lemons.—With small $2\frac{1}{4}$ inch lemons the packer is sometimes tempted



3-2 pack.



2-2 pack.

Lemons packed in the Dump case for local market.

Note.—The last lemons in each layer should be reversed in order that the button and not the point is against the end of the case.

A general view of the interior of a Victorian citrus packing house.

to bring the 5 x 5 layer into use with 8 layers in the case. In most instances the fruit will be too low in the case. The fault can be remedied by making the "layer count" 5 x 4, instead of 5 x 5. This means there will be less fruit in each layer, but the spaces between the lemons will be larger, and permit 9 layers in the case (instead of 8) with a total of 203 lemons and the fruit will be raised to the correct height.

Specifications of timber required to make the Australian "Dump" Bushel case, inside measurements, are as follow :—

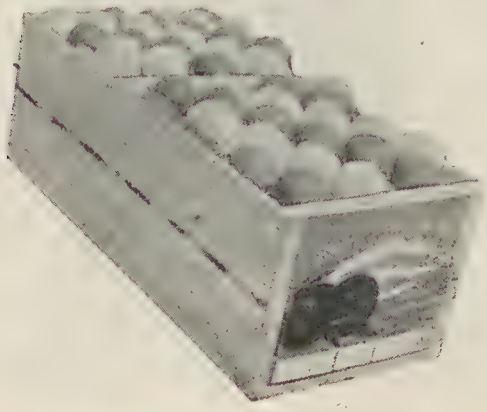
18 x 18⅜ x 14¼ *inches.*

2 Ends, one piece each, 14¼ inches x 8⅜ x ¾ inch.

2 Sides three pieces each 19½ inches x 4⅝ inches x ⅜ inch.

Lids and Bottoms one piece each 19½ inches x 8⅜ inches x ¼ inch.

NOTE.—Two-piece sides are preferable to three-piece sides, and one-piece lids and bottoms are preferable to those of two pieces.



The Californian or 25-inch Lemon Box.

PACKING CHART FOR LEMONS FOR EXPORT IN THE CALIFORNIAN LEMON BOX.

(25 x 13 x 10 inches, inside measurements clear of the division.)

Approximate Size.	Pack.	Layer.	Layers.	Total.	Remarks.
2⅛″	4–3	4 x 4	6	336	If lemons are not drawn too closely together in the bottom layer, the pockets thus formed greatly improve the "nesting" system of the fruit. This is an important factor in successful transport.
2¼″	4–3	4 x 3	6	294	
2⅜″	4–3	3 x 3	6	252	
2½″	3–3	4 x 3	5	210	
2⅝″	3–3	3 x 3	5	180	

Specifications of timber required for the Californian Lemon Box :—

Ends and centre, 3 pieces, 13 inches long, 10 inches wide, 11-16ths inch thick.

Sides, 4 pieces, 27 1-16th inches long, 4½ inches wide, ¼ inch thick.

Bottoms, 2 pieces, 27 1-16th inches long, 5¾ inches wide, ¼ inch thick.

Lids, 2 pieces, 27 5-16ths inches long, 5¾ inches wide, 3-16ths or 5-32nds inch thick.

Cleats, 2 pieces, 13 inches long, ¾ inch wide ⅜ inch thick.

NOTE.—Lids are cut ¼ inch longer to allow for the bulge.

Lemons for Interstate Trade.

If the following market requirements are adhered to, many disappointments may be avoided:—

1. Do not send lemons from Victoria to an interstate market unless each lemon is wrapped in sulphite tissue wrapping paper.
2. Do not send lemons larger than the 140 count ($2\frac{5}{8}$ inches), or smaller than the 248 count (2 inches).
3. Make sure the counts are accurate before branding the cases.
4. Large, rough or corrugated lemons are not wanted in interstate markets.
5. All cases for the interstate trade should be wire-tied to prevent loss and breakages during transport.
6. The best time to consign lemons to Queensland is from the middle of October until March.

GRAPEFRUIT.

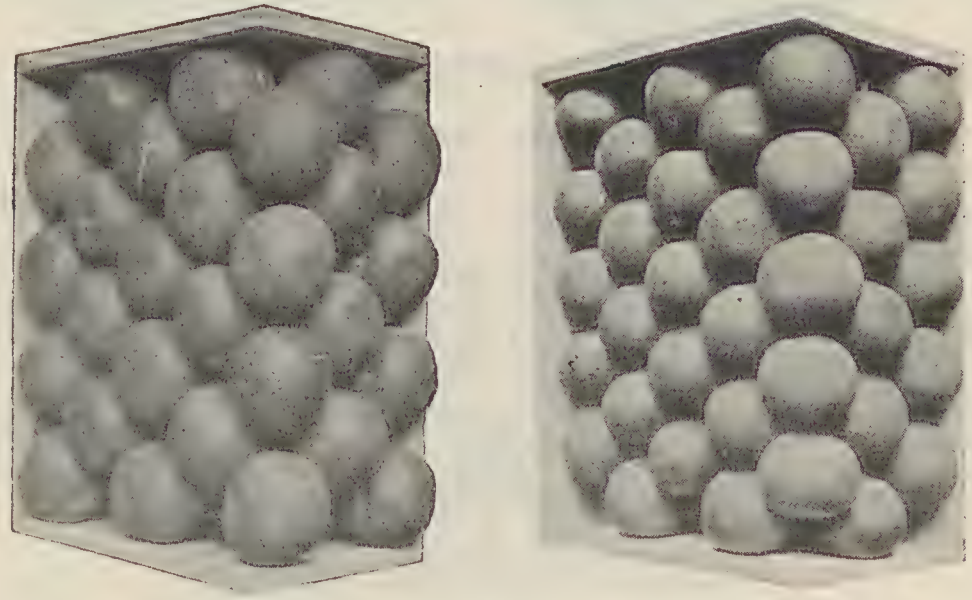
The attractive presentation of grapefruit in the local markets is difficult to attain, compared with oranges. The former is such a notorious shrinker that unless certain precautions are taken, slack packs are difficult to avoid.

Although after a week or ten days off the tree, grapefruit frequently appear as if they have only just been harvested, the fruit should be sweated

PACKING CHART FOR GRAPEFRUIT IN THE "DUMP" BUSHEL CASE.

Approximate Size.	Pack.	Layer.	Layers.	Total.	Remarks.
3″	2–2	5 x 4	7	126	Cheeks to side of case like oranges
$3\frac{1}{8}$″	2–2	4 x 4	7	112	Stylar end to side of case
$3\frac{1}{4}$″	2–2	4 x 4	6	96	Stylar end to side of the case
$3\frac{3}{8}$″	2–1	6 x 5	5	83	Cheeks to side of case like oranges
$3\frac{1}{2}$″ / $3\frac{5}{8}$″	2–1	5 x 5	5	75	Cheeks to side of the case like oranges
$3\frac{3}{4}$″	2–1	5 x 4	5	68	Stylar end to side of the case
$3\frac{7}{8}$″	2–1	4 x 4	5	60	Stylar end to side of the case
4″ / $4\frac{1}{8}$″	2–1	4 x 3	5	53	Stylar end to side of the case
$4\frac{1}{4}$″ / $4\frac{3}{8}$″	2–1	3 x 3	5	45	Stylar end to side of the case
$4\frac{1}{2}$″	2–1	3 x 2	5	38	Stylar end to side of case. Pack loosely.

NOTE.—In order to maintain the maximum size that will fill the cases properly with each count, it is very important that the fruit in each of the packs are placed according to the manner set out in the "Remarks" column. If this is not adhered to, the grapefruit will not come to the desired height in the case when the packing is finished.



Two cases of grapefruit packed for the local market. Note.—Left, the stylar ends face the side of the case; right, cheeks face the sides of the case like oranges.

Packing Citrus in the Shepparton District.

slightly to ensure a good firm pack that will keep reasonably well after the retailer has purchased it. Sweating undoubtedly improves the pack considerably. The natural keeping qualities of grapefruit are very marked, and it is not necessary, therefore, to sweat them to the same extent as lemons.

Unlike oranges, heavy loss in the market, due to waste, does not occur with grapefruit at the present time. Irregular packs have been so prevalent, however, that the accompanying packing chart is submitted as a guide which should help to overcome many of the difficulties experienced at present.

Fertilizers Act

Prosecution for Offence.

AT the North Melbourne Court of Petty Sessions on the 16th of December, 1936, before Mr. R. Mohr, P.M., Albert George Pennell, Fertilizer Manufacturer of Braybrook, was charged with an infringement of the *Fertilizers Act* 1928 in that a sample of A.N.A. Surprise Animal Fertilizer, taken from a parcel of the fertilizer found at the works of the defendant, on analysis was found to contain a smaller percentage of nitrogen than the proportion certified on the label attached to each bag. This deficiency amounted to three-quarters of one per cent., which is contrary to Section 16 of the Act. It was stated in evidence that the sample of the fertilizer taken was worth only £6 2s. 3d. per ton when calculated by the unit value system, while the guaranteed value calculated by the same system on the analysis of the tag, was £7 1s. 10d., and the registered price was £7 10s. per ton.

Mr. T. Mornane of the Crown Law Department appeared for the Department of Agriculture and Mr. Norman Mitchell appeared for the defendant, who was convicted and fined £2 with £2 12s. 6d. costs.

Goodyear Announces
THE BEST "ALL-FARM-WORK" TRACTOR TYRE *Ever built!*

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To sum up its advantages to farmers, it has:

(1) **"100% MORE SHOULDER TREAD".** Thick lug bars around the shoulders! Deep notches!

(2) **"30% MORE DRAWBAR PULL".** Increased non-skid depth! More ground contact!

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(4) **"48% MORE RUBBER".** Greater strength! Longer life! More puncture resistance!

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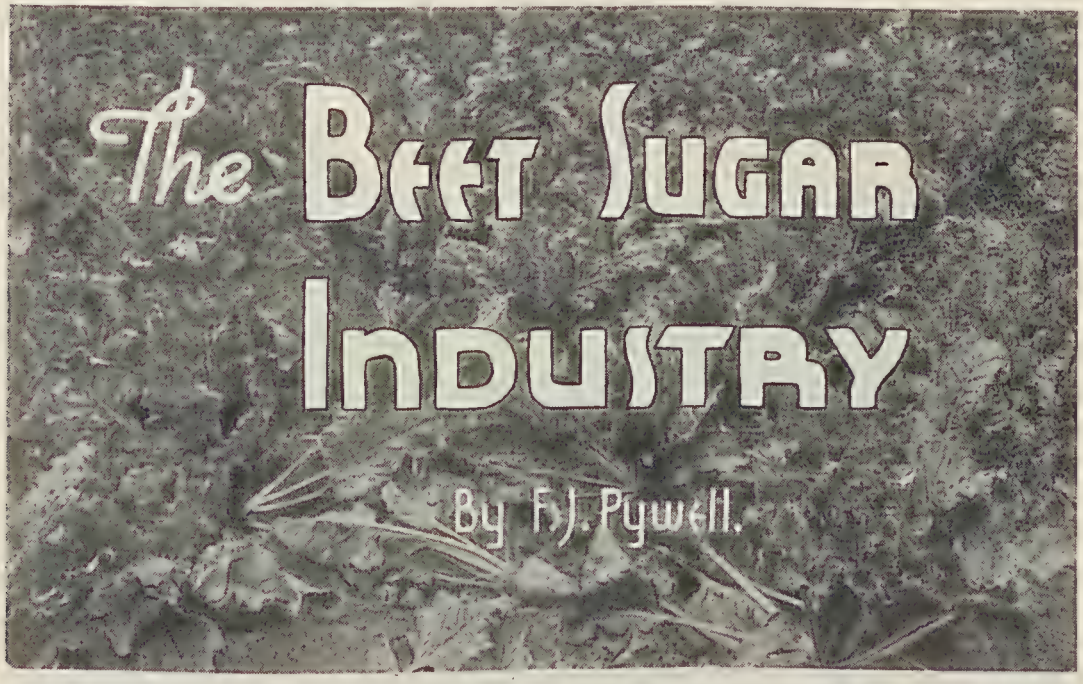
ONLY HIGH ANTI-KNOCK PETROL CAN GIVE FULL KNOCKLESS POWER

The mechanical brutality of knocking makes men who appreciate good engines shudder at the sound. Knocking—caused by ordinary petrols—batters vital parts and robs engines of their power. Change to Super Plume Ethyl and enjoy full knockless power, maximum mileage and lessened depreciation because of complete absence of knocking.

Super Plume Ethyl

For KNOCKLESS Power



IN Australia, sugar was first made on a commercial scale at Ormiston, near Brisbane. This was in the year 1865, the sugar being obtained from cane, experiments in the growing of which had been made in Queensland as early as 1860.

In 1866, beet was grown in Victoria; it was not used, however, for the making of sugar, but for the distillation of spirit. This work was carried out in a factory on the Saltwater (now Maribyrnong) River, which was under the control of Mr. Nathaniel Levi. In 1870, Mr. Levi was granted letters patent for the manufacture of beet sugar in Victoria, and in the year 1873, a factory was erected at Anakie near Geelong. Many difficulties were met with in working the machinery, all of which had to be imported, and there was also unlooked-for trouble in the extraction processes. The factory was then purchased by Mr. Murray Ross and removed to Rosstown (now Carnegie), where beet was grown in small areas, mostly by market-gardeners. Owing to faulty methods of cultivation, the returns to growers were smaller than expected, and this, with losses on the manufacturing side, led to the closing of the factory.

During these years, the cane sugar industry was growing in Queensland; but there, too, reverses were met with, and between 1880 and 1890 many small mills were forced to close down. In 1887 a Government mill was built in the Mackay District. Later several others were erected with Government assistance. Gradually the advances made for the construction of most of these mills were paid off and they became co-operative concerns, and formed the secure foundation of an industry whose annual worth is now in the region of £10,000,000.

Some years after the failure of the Rosstown factory in Victoria, experiments in the growing of beets were made from time to time at Warrnambool, Narre Warren and Maffra. In 1896 a company was formed for the erection of a factory at Maffra, and a sum of £75,000 (which included a Government advance of £63,000) was expended on buildings and plant. In 1897 a factory capable of treating 400 tons per day was completed, and some of the farmers in the surrounding district planted considerable areas of beet. They were, however, dissatisfied with the amounts received for their crops; the financial returns on the sale of sugar were likewise unsatisfactory, and after operating for two years the factory was closed.

For the next ten years the plant was idle, but the Government, which had taken it over, kept the building and machinery in good order. During this time occasional experimental plots were sown, and in 1909 a revival of interest was shown by several farmers. Dr. Walter Maxwell was invited to report on the prospects of the industry. As a result of his recommendations, the factory was placed under the control of the Department

of Agriculture, and in 1910 it was reopened after the installation of some additional machinery to improve the method of extracting the sugar from the beets.

The seasonal conditions in 1911 were good, but the area sown was small. It would no doubt have increased, but unfortunately the following six seasons were dry and yields were disheartening. Not only were the seasons adverse, but growers were inexperienced, and many of them found it difficult to arrange for the transport of their beet to the factory. By 1914 the total area of beet harvested was 1,000 acres, but two years later it fell to less than one-half of this.

With the object of helping the cane growers of Queensland, where the employment of coloured labour had been gradually abolished, the Commonwealth Government in 1915 prohibited the importation of sugar into Australia. Very soon, however, there was no need for any such ban, for during the war years of 1914–1918, and in the few years following, there was a world shortage of sugar. However, when the crops in sugar-producing countries became normal again, the embargo came into operation and was of help to the beet sugar industry as well to cane-growers. Since then the Victorian beet sugar industry has suffered only minor set-backs. In 1925 the services of an expert from the United States were obtained to advise on the improvement of the factory. He submitted a comprehensive report and suggested that it should be remodelled and that the capacity of the plant should be increased. His recommendations were approved by the Government, and the work was carried out.

TABLE I.—ACREAGE OF BEET HARVESTED, QUANTITY TREATED, ETC., FROM 1911 TO 1936 (BOTH INCLUSIVE).

Year.	Acres Harvested.	Tons of Beet Treated.	Average Tons per Day Cut.	Tons of Sugar Manufactured.	Tons of Molasses Produced.
1911 ..	458	5,970	74	482	..
1912 ..	752	3,975	92	519	266
1913 ..	900	6,208	109	648	362
1914 ..	1,000	7,432	140	920	435
1915 ..	990	8,843	153	1,182	468
1916 ..	461	4,928	110	560	252
1917 ..	1,320	15,159	190	1,948	480
1918 ..	1,200	14,487	207	1,650	344
1919 ..	1,009	12,289	236	1,263	460
1920 ..	1,080	13,084	238	1,551	550
1921 ..	1,180	7,147	204	833	537
1922 ..	1,602	16,577	272	1,872	840
1923 ..	2,045	20,444	288	2,784	902
1924 ..	1,937	29,512	335	3,499	1,448
1925 ..	1,897	24,467	318	3,017	1,144
1926 ..	1,880	21,193	365	2,315	822
1927 ..	2,024	9,079	293	1,176	444
1928 ..	2,353	24,344	348	2,349	890
1929 ..	2,130	14,596	332	2,108	635
1930 ..	2,500	25,088	358	3,472	1,170
1931 ..	3,045	36,968	373	5,195	1,482
1932 ..	3,173	41,984	412	5,428	1,619
1933 ..	3,155	35,437	431	5,701	1,585
1934 ..	3,234	48,038	454	5,303	1,816
1935 ..	3,097	38,659	421	4,570	1,550
1936 ..	3,165	35,843	521	5,115	1,379

When in 1929 the Glenmaggie Weir was completed and water for irrigation became available, growers were enabled to ensure against loss owing to drought, and to-day approximately half the

The Maffra Beet Sugar Factory.

Showing the Beets, after weighing, being delivered into the Beet Bins.

beets supplied to the Maffra factory are grown under irrigation.

Details of the areas harvested, the quantity of beet treated for the years 1911 to the present one are set out in Table I., while in Table II. is given the wholesale price of sugar for the years 1910 to 1936.

TABLE II.—WHOLESALE PRICE OF SUGAR IN AUSTRALIA FROM 1910 TO 1936 (BOTH INCLUSIVE).

Year.	Price.	Year.	Price.
	£ s. d.		£ s. d.
1910 to 1912	22 12 6	1921 and 1922	49 0 0
1913 and 1914	22 2 6	1923 ..	45 0 0
1915 ..	25 12 6	1924 and 1925	37 11 4
1916 to 1919	29 7 6	1926 to 1933	37 5 0
1920 ..	36 0 0	1934 to 1936	33 4 0

The Industry at Maffra.

There are at present (1936) 164 growers in the Maffra district. The average area planted by each grower is 20 acres; the smallest area is 5 acres and the largest 60 acres. The cost of growing and harvesting an average crop of beets on present contract rates is £15 8s. 1d. per acre. This estimate is based on all operations being carried out by contract labour, the grower himself doing nothing but supervise the work. The average gross return over the past ten years has been £21 13s. 10d. per acre, which leaves a clear profit of £6 5s. 9d. per acre. In nearly every case some of the work is done by the grower, so that his net return would be correspondingly greater.

At various stages during the growing of the crop and at harvesting time about 250 men are employed in the fields. The factory employs 200 men on shift work during the manufacturing campaign, which lasts about four months; the wages bill of the factory is about £18,000 per year. All mechanical repairs, excepting those of a major kind, are carried out by the staff in the factory's workshop.

Various materials are required in the manufacturing process, including the following:—

Briquettes—about	7,000	tons per year
Coke—about	300	,, ,,
Lime-rock—about	3,000	,, ,,
Sugar bags—about	170,000	per year

The beet pulp is always in great demand by dairy farmers, as it is a noted stimulant in milk production. Stock fatten exceedingly well on beet tops, and when they are available there is a greater demand for store stock than at other times.

Fattening stock on the by-products is carried out extensively in America. Molasses is mixed with pulp and also with lucerne for feeding purposes. Well-conditioned store stock are placed in corrals and are fattened very quickly. Usually beet tops, together with a little hay, are added to the ration. Grain and molasses are also much used there in the topping off of sheep.

Thinning out Beet Plants in the Maffra District.

An analysis of the profit and loss account since the re-opening of the factory in 1912–13 up to June, 1936, is set out in Table III.

TABLE III.—ANALYSIS OF PROFIT AND LOSS ACCOUNT.

Year.	Capital.	Receipts including Increase or Decrease in Stocks.	Expenditure.	Profit.	Loss.
	£	£	£	£	£
1912–13 (six months)	76,416	14,557	18,136	..	3,579
1913–14 ..	79,432	22,630	32,935	..	10,305
1914–15 ..	79,520	28,766	31,552	..	2,785
1915–16 ..	78,682	22,406	25,595	..	3,189
1916–17 ..	81,391	54,510	46,496	8,014	..
1917–18 ..	81,708	53,346	51,478	1,868	..
1918–19 ..	82,068	41,360	43,142	..	1,782
1919–20 ..	82,354	72,792	56,043	16,749	..
1920–21 ..	83,614	49,999	44,723	5,276	..
1921–22 ..	83,732	77,123	67,203	9,920	..
1922–23 ..	87,443	97,231	83,940	13,290	..
1923–24 ..	93,421	105,179	86,162	19,017	..
1924–25 ..	99,906	134,013	110,871	23,142	..
1925–26 ..	117,264	97,182	91,653	5,529	..
1926–27 ..	117,264	62,042	61,187	855	..
1927–28 ..	117,264	89,551	96,500	..	6,949
1928–29 ..	117,341	78,030	72,377	5,653	..
1929–30 ..	117,311	107,296	89,955	17,341	..
1930–31 ..	117,311	191,070	138,704	52,366	..
1931–32 ..	117,299	154,144	134,726	19,418	..
1932–33 ..	117,393	185,032	128,823	56,209	..
1933–34 ..	117,296	203,951	138,752	65,199	..
1934–35 ..	117,045	159,585	131,510	28,075	..
1935–36 ..	117,035	159,019	126,228	32,791	..
		2,260,814	1,908,691	380,712	28,589
Remodelling expenses in 1927–28 charged against previous profits (less) ..			21,552	21,552	
			1,930,243	359,160	
				28,589	
				330,571	

In America the beet sugar industry has made rapid progress since the eighties, and to-day (1936) 105 beet sugar factories there treat beets from 1,000,000 acres.

The Great Western Sugar Company of Colorado controls 28 factories for an annual production of approximately 400,000 tons of refined sugar. The Oxnard factory in California has a slicing capacity of 4,000 tons per day (24 hours), and is therefore capable of treating at least 400,000 tons of beet in a campaign.

In the United States a campaign is usually reckoned to be 100 days, but of course varies with seasonal conditions, which play a large part in the quantity of beets produced, and the tonnage the factories are required to treat. The usual variation in the duration of a campaign is 80 to 120 days; at Maffra it is much the same.

The world's annual production of sugar is approximately 29,249,000 tons, made up as follows:—From cane, 17,720,000 tons; from beet, 11,529,000 tons.

The annual consumption of refined sugar in Australia is approximately 320,000 tons, of which Victoria consumes 90,000 tons; the quantity per person is 112 lb.; in America it is 80 lb., while the average for the world is 28 lb.

Method of Extracting Sugar from Beets.

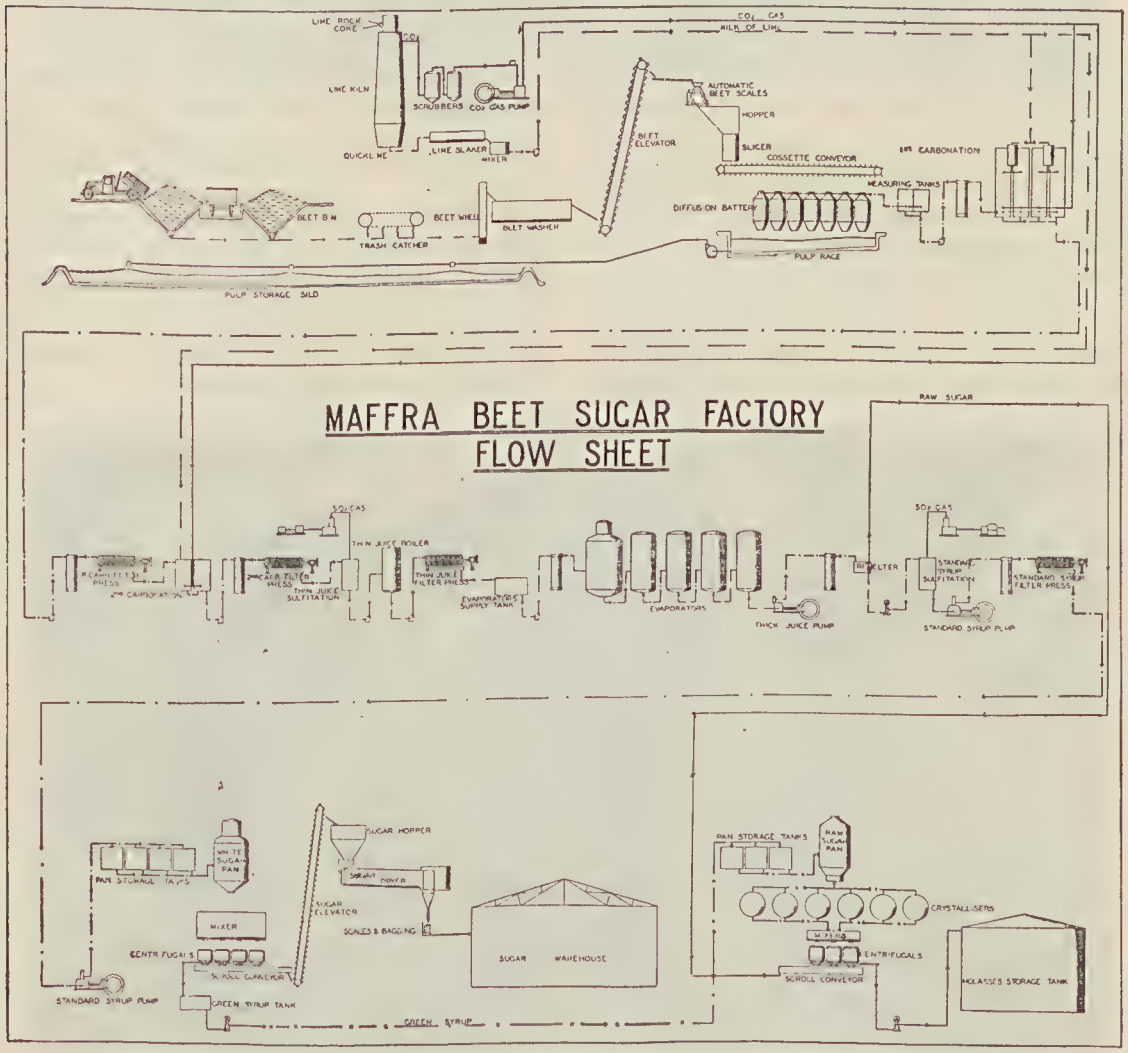
The steps taken at the Maffra factory in the extraction of white sugar from the beets are as follow:—

Beets are weighed at the receiving station, and any deductions on account of improper topping, adhering soil, &c., are made. The total deduction is termed the "tare".

They are then delivered into bins at the factord (the first station shown on the Flow Sheet), any conveyed, through flumes filled with running

water, to the trash catchers where weeds, &c. are removed. They then pass through to the beet wheel which elevates them from the flumes into one end of the beet washer where they are agitated in contact with water, and by a special arrangement of the arms the clean beets are thrown out at the other end. The beet elevator raises the beets to the automatic scale which automatically weighs, registers, and dumps the beets into the beet hopper. From the hopper the beets pass to the slicer, a large cylindrical machine, where, by means of a set of fast revolving knives they are cut into long "V" shaped slices (Cossettes). The object of this is to obtain as much acting surface as possible for the subsequent extraction of sugar from the cossettes in the diffusion process. The amount of sugar entering the factory is calculated from the percentage of sugar in the cossettes and from the weight of the beets sliced. The sugar percentage is obtained from analysis made on hourly samples of cossettes taken from the chute as they enter the diffusion battery.

The cossettes are conveyed from the slicer by the cossette conveyor to the diffusion battery consisting of fourteen cells, each of which holds approximately 2½ tons of cossettes. By circulating hot water of varying temperatures at a pressure of from 20 to 25 lb. per square inch through the cells, the sugar diffuses into the water until equilibrium is attained and the circulation of hot water is continued until as



Showing the steps taken at the Factory in the Extraction of Sugar from Beets.

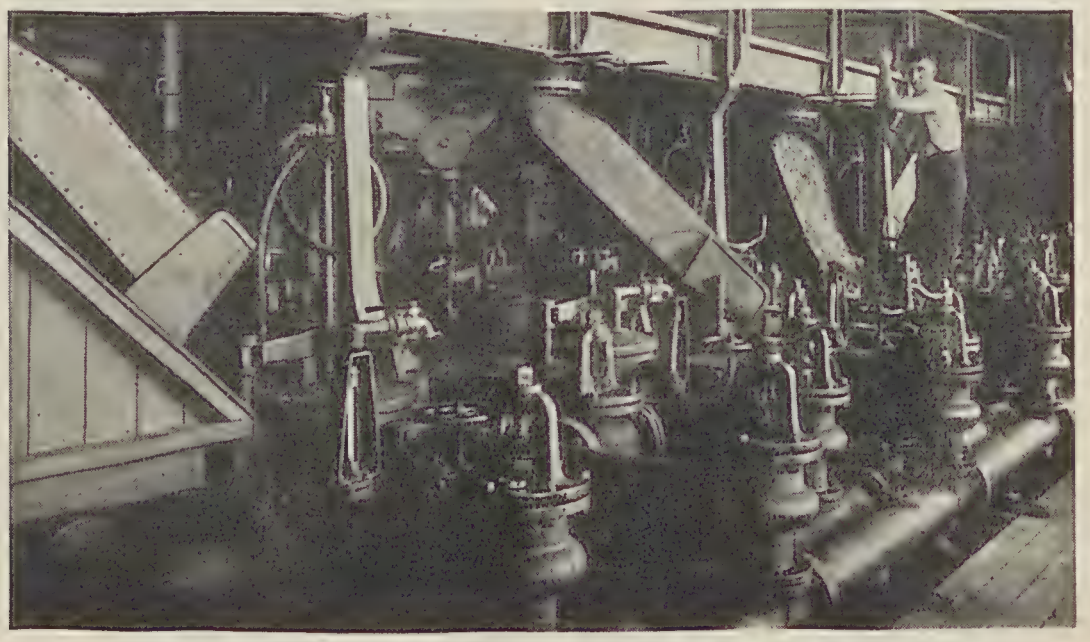
much sugar as is economically sound is extracted from the cossettes. The exhausted cossettes (pulp) are dumped into the pulp race and pumped to the pulp storage silo from which they are sold for stock food.

The juice, having by diffusion finally attained a high percentage of sugar, is drawn from the battery in definite quantities into the measuring tank from which it is pumped through a heater to the first carbonation station. At this point the required quantity of lime milk is added and the resulting precipitate of calcium monosaccharate is decomposed by gassing with carbon dioxide gas thus setting the sugar free while most of the impurities contained in the juice remain in the precipitate.

The carbon dioxide gas is produced by burning mixture of limestone and coke in the lime-kiln. The gas is drawn off through the scrubbers by the gas pump which delivers it to the carbonation station. The lime milk is made by slaking quick-lime from the kiln in the lime slaker, from which it passes into the mixer and is finally pumped to the carbonation station. The juice from the carbonators is pumped through a heater to the filter presses, where the precipitate is retained and the clear straw-coloured juice runs out of the press to the second carbonation station where the juice is once more treated with lime milk and carbon dioxide gas. On completion of the second carbonation the juice is pumped through a heater and filtered in a similar set of presses to those used for the first carbonation juice.

The next step is to treat the juice with sulphur dioxide after which it is called thin juice. The sulphur dioxide (SO_2) is produced by burning nut sulphur in a specially designed stove. The thin juice is then boiled in the thin-juice boiler and pumped through filter presses to the evaporator supply tank, from which it is pumped through a heater to the evaporators. By boiling under vacuum in the evaporators the thin juice is boiled down to about 60° Brix. and is now called thick juice. The thick juice is pumped from the fifth evaporator through a heater to the remelter, where the raw sugar from the centrifugals situated under the crystallizers is dissolved to form standard syrup. The standard syrup is pumped to the standard syrup sulphur station and treated with sulphur dioxide after which it is pumped through a heater and filter press and then pumped to the pan storage tanks.

The standard syrup is now boiled in the white sugar pan to crystallize the sugar. The white massecuite, as it is now termed, is discharged into the mixer and from there it passes to the centrifugals where it is spun at a high speed, separating the sugar crystals and the green syrup of which the massecuite consists.



The Diffusion Battery which is situated at the Beet end of the Extraction Process.

At the Beet end—Showing Clarification Tanks on the Left and Battery on the Right.

The scroll conveyor discharges the moist sugar crystals into the sugar elevator which elevates them to the sugar hopper from where it passes to the sugar dryer. After drying the sugar is bagged and stacked in the warehouse.

The green syrup is pumped from the green syrup tank to the pan storage tanks situated alongside the raw sugar pan into which it is drawn and boiled forming raw massecuite. The raw massecuite is discharged from the raw pan into the crystallizers to mature. After maturity the raw massecuite is spun in centrifugals separating the raw sugar (brown sugar) and molasses, the raw sugar passing to the scroll conveyor and then to the remelter, and the molasses is pumped to the molasses storage tank from which it is sold. The raw sugar is melted and returned to the system by mixing it with thick juice.

Cultivation of Sugar Beet.

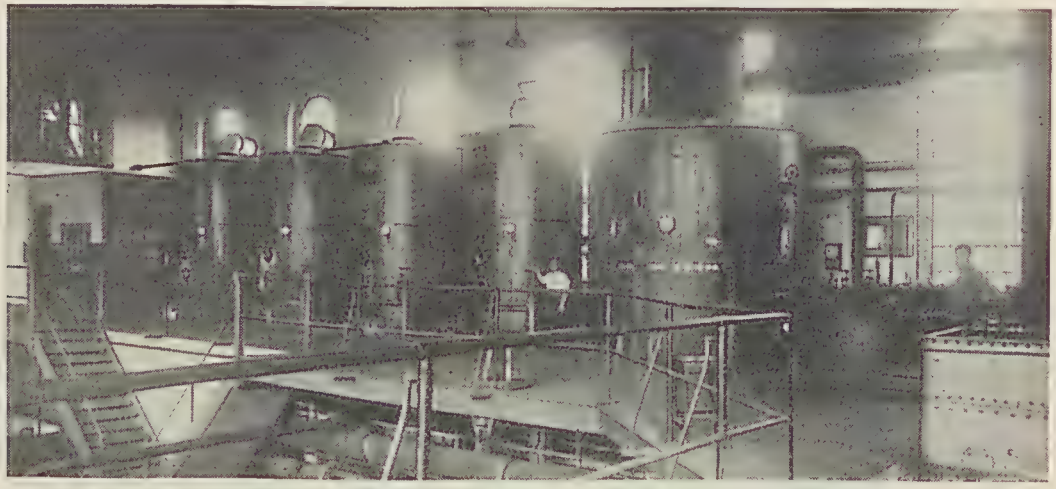
A good depth of soil with a reasonably free subsoil is required to grow a profitable crop of sugar beets. In the Maffra district they are grown on a variety of soils; the heavy types usually produce payable crops, but the light loams under irrigation give heavier yields and beets with a greater sugar content.

When considering the various cultural operations necessary for a beet crop, it should be realized that it is necessary to obtain as deep a tilth as possible without bringing any raw sub-soil to the surface.

Lack of air and the presence of excessive water cause the soil to become acid and cold, and the beets are liable to be affected by such conditions. Good drainage, the judicious application of lime, and the ploughing in of long stubble, green manure, &c., with thorough cultivation, will tend to keep the soil in suitable condition.

In order to obtain roots of a good shape, air must be given access to as great a depth as

Lifting Beets with a Special Two-point Lifter.



The Evaporators where the thin juice is transformed into thick juice.

possible. This will also tend to a more even distribution of moisture, and increases the activity of the beneficial soil bacteria. For these reasons, it is strongly recommended that the land be ploughed deeply and worked down in the late autumn and allowed to lie fallow throughout most of the winter. Sufficient cultivation should be given to keep it free and to prevent the growth of weeds. A firm seed-bed with a fine tilth must be prepared at least one week before planting, when the harrow should be taken ahead of the drill to kill any weeds that have commenced to grow.

Topping the Beets.

The most suitable period for planting is usually from the latter end of August to the end of September, but this, of course, must sometimes be slightly varied if weather conditions are adverse.

Seeding should be at the rate of 12 to 16 lb. per acre, the seed being planted in rows 18 inches apart and from ½ inch to 1 inch deep. The depth will be governed by the time of planting and the condition of the seed-bed.

Superphosphate is usually planted with seed at the rate of 100 lb. per acre. Excellent results have been obtained by applying a dressing of superphosphate prior to planting with a grain-drill, and reducing the quantity of fertilizer planted with the seed.

The crop should be cultivated as soon as it is possible to see the rows. Plants should be thinned out to from 8 inches to 10 inches apart before they are more than 2 inches high. Cultivations are necessary at frequent intervals, particularly after rain or irrigation. Side-hoeing is carried out with long-handled hoes to destroy all weeds missed by the cultivator.

Harvesting commences in March. The beets are lifted with a horse or tractor drawn special two-point lifter, after which they are "topped," the leaves and crown being cut away to the

OVER 200,000 GRIPS

Two Hundred Thousand Grips were Sold during 1936 in Australia by the Manufacturers of

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The New

DUNLOP 90

GIANT TRUCK TYRE

—the greatest achievement in the history of commercial vehicle tyre manufacture

Now manufactured for the first time in Australia—the Dunlop Giant "90" truck tyre—famous and proved the world over.

It OFFERS and ENSURES

- UNPRECEDENTED MILEAGE.
- GREATER SAFETY UNDER ALL ROAD CONDITIONS.
- A PROVED NON-SKID TREAD.
- LOWER MAINTENANCE COSTS.

FACTS ABOUT THE DUNLOP "90"

The deeper tread of "tough compound" rubber gives at least 15% more mileage. The "flat," full-width road-contact of its five-rib pattern gives unequalled grip—and protection from both side and forward skids. Remarkable casing life is given by Weftless Cord and the "Disc Doubling" processing of every cord—both exclusive to Dunlop interests in Australia.
Weftless Cord eliminates the destructive heat which saps the life of ordinary truck tyre casings. Disc Doubling, by giving more "twist" to the cord during manufacture, provides greater stretching power—allowing the Dunlop "90" casing to flex under the heaviest load without injury or "fatigue."

HAVE NO TRUCK WITH INFERIOR TYRES . . . FIT DUNLOP "90"

Dunlop Perdriau Rubber Co. Ltd.
Branches all States

lowest leaf bud. The topped beets are then carted to the factory where they are weighed before being tipped into the beet bin.

The most favorable climatic conditions for sugar beet are found where the mean summer temperature is about 70° F. with a maximum monthly rainfall during the summer of 2 inches. The ideal climate may be stated as follows:—Comparatively dry and warm spring months during the time of preparation of the soil and planting and cultivating; moderate temperature and abundant and frequent rains during the summer months, and a cool dry autumn for ripening and harvesting the crop.

The rainfall records and the average yield per acre in the Maffra district for the years 1911–12 to 1935–36 are given in Table IV.

TABLE IV.—RAINFALL RECORDS—AVERAGE YIELD PER ACRE—SUGAR CONTENT.

—	April to September.	October to March.	Tons per Acre.	Percentage Sugar.
	Inches.	Inches.	Tons.	%
1911 ..	8·96	19·64	13·0	13·90
1912 ..	9·71	6·97	5·3	19·20
1913 ..	9·19	12·19	6·9	14·50
1914 ..	9·34	8·88	7·4	17·10
1915 ..	6·96	7·62	8·9	17·20
1916 ..	7·65	12·61	10·7	15·45
1917 ..	11·91	11·82	11·5	15·85
1918 ..	9·36	15·45	12·0	14·45
1919 ..	13·37	9·47	12·1	13·39
1920 ..	11·91	14·53	12·1	15·00
1921 ..	9·34	12·21	6·0	15·13
1922 ..	9·64	9·80	10·3	14·90
1923 ..	12·80	9·05	10·0	18·00
1924 ..	10·63	17·38	15·2	16·00
1925 ..	8·68	14·06	12·9	17·24
1926 ..	10·93	9·91	11·3	15·30
1927 ..	10·61	6·12	4·9	16·51
1928 ..	7·65	19·75	10·8	12·56
1929 ..	6·10	8·45	7·2	17·94
1930 ..	7·65	9·17	10·6	17·00
1931 ..	11·94	18·52	12·6	16·48
1932 ..	8·97	16·32	13·6	15·91
1933 ..	13·27	9·43	11·7	19·25
1934 ..	11·66	16·34	15·6	13·91
1935 ..	9·95	21·74	13·2	15·06
1936 ..	14·76	17·07	11·9	17·12

Bagging and Weighing Beet Sugar.

Carting the Topped Beets to the Factory.

DESIRABLENESS OF CROP ROTATION.

Experience has proved that rotation of crops is essential to maintain the land in good physical condition and prevent disease.

Leaf spot is by far the most prevalent disease in the Maffra and Lindenow districts. A significant feature noted in connexion with the disease is that the most severe attacks usually occur in the second or third successive crops on the same area. This was strikingly demonstrated on a Lindenow property, where

in the 1934–35 season half a paddock was sown to beet and the other half to oats. In 1935–36 beet was sown over the whole field, and that part of the crop on the area which the previous year had been sown to beet and had yielded heavily became very much infected with leaf spot, while the portion that had followed the oats was clean; this section subsequently developed

	Average Yield of Beet.		Average Yield of Sugar.	
	Rotated Area.	Non-rotated Area.	Rotated Area.	Non-rotated Area.
	Tons per Acre.	Tons per Acre.	Tons per Acre.	Tons per Acre.
Dusted ..	15·72	7·45	2·68	1·28
Undusted ..	11·77	6·71	2·03	1·11

leaf spot, though not so severely as the first section.

Experiments carried out last year (1935) at Maffra provide further evidence of the value of crop rotation; the difference between the area which had grown beet for two seasons previously as against that on which beet had been preceded by oats was most striking. Growth on the latter portion was far superior from the time of germination to the date of harvesting. The differences in yield of both beet and sugar from the two areas and the effect of dusting with Bordeaux dust are shown in the previous column.

The Bordeaux dust used was a mixture containing 20 per cent. monohydrated copper sulphate and 80 per cent. hydrated lime. This was applied at the rate of 45 lb. per acre in four dustings in December, January, and February (two).

The following table compiled from reports of 500 American farmers shows the average increase in yields of cereals and other crops after sugar beet had been introduced into the rotation :—

Crop.	Yield per Acre before Beet Culture.	Yield per Acre after Beet Culture.	Increase.	
			Yield.	Percentage Increase.
	Bushels.	Bushels.	Bushels.	%
Wheat ..	29·98	44·93	14·95	49·87
Maize ..	55·42	71·93	16·52	29·81
Oats ..	45·65	68·70	23·05	50·49
Barley ..	42·26	66·30	24·04	56·86
Potatoes ..	196·56	285·31	88·75	45·15
Beans ..	15·28	21·42	6·14	40·18

The Warehouse at the Maffra Beet Sugar Factory containing 2,000 tons of Sugar.

Prune Drying

Seasonal Notes

By

D. G. Quinn, Viticulturist

The popular d'Agen prune.

FOR some years past the Australian public has been steadily absorbing larger quantities of prunes, and the credit for increasing the popularity of this fruit is largely due to recent improvements in the curing procedure. These improvements have been brought about in the first place by the grower and secondly by the packer. This article is prepared with the object of indicating to the grower the points he must observe in order that the packer can finally convert orchard-dried prunes into a product which the public can use with relish, instead of, as has often been the case in the past, from a sense of medical duty.

Picking Stage.

Any fruit which is not sufficiently ripe when picked for curing dries hard and tart, and does not respond to the final processing methods applied by the packer. Melbourne packers complain that nearly 30 per cent. of their consignments are faulty in this direction. Prunes of this type may sell freely, because they are cheap, but there is quite a large body of potential consumers who absolutely avoid prunes because of their fear of this class of fruit. Sugar accumulates very rapidly in the prune during the last few days of ripening, and from the time prunes can be shaken off until they drop naturally, a rise of about 11 per cent. in their sugar content occurs, although their total weight may rise 1·6 per cent. only, because of lost moisture. (Oregon Experiment Station, Bulletin 145.)

Some fine trees of the Robe de Sergeant variety.

Prunes do not ripen evenly, and so, with the exception of the Goulburn Valley variety, the only way to ensure full ripeness is to allow the fruit to wilt and fall from the tree naturally. As prunes approach the ripening period there usually is a premature drop, and this fruit should be carefully discarded. Often a watering or harrowing to smooth the ground serves the dual purpose of getting rid of the early drop, and simplifies the gathering of the good fruit later. All prunes should be gathered at frequent intervals when the crop starts to fall and, as this work is usually done by contract, the practice of

shaking the limbs should not be allowed until the final picking.

The variety, Robe de Sergeant, owing to its tender skin, should be gathered more frequently than D'Agen, for it quickly spoils if left lying on the ground in the hot sun. Lack of attention in this respect is possibly one reason why Robe de Sergeant is unpopular with local packers, who, at the same time, speak highly of the Goulburn Valley prune, provided this late variety is allowed to ripen properly.

With regard to the matter of size, it is well known that, by normal cultural attention and light pruning, the D'Agen will bear almost as heavy a crop of fruit, averaging 60 to 70 per pound, as compared with counts of 100 to 120 obtained without this attention. The larger grade of fruit naturally is cheaper to gather and process, and last year was worth 2d. per lb. more on the Australian Dried Fruits Association price list to merchants.

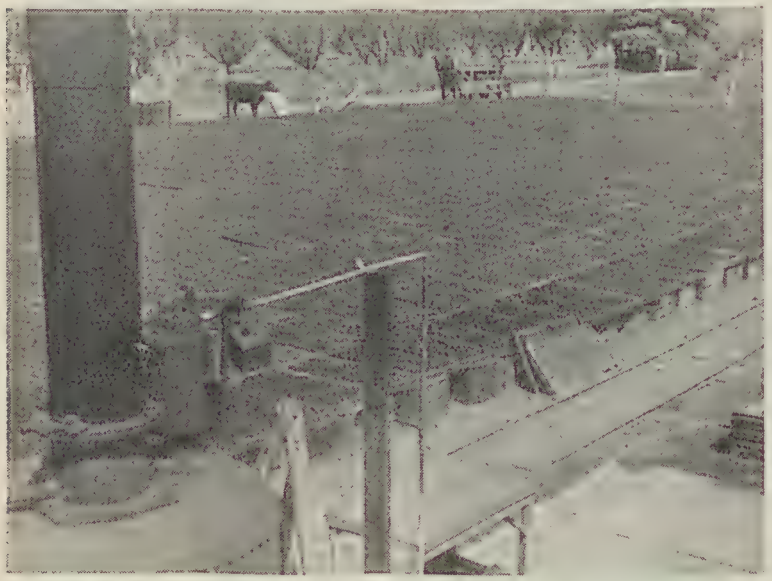
Although preferring prunes of reasonable size, packers report there is a good demand for small prunes, provided they are sweet, fleshy, and well dried, but the fruit which they dislike is that which is picked prematurely, or that where two varieties have been mixed. Dust on the fruit is of no account, as this is eliminated in the dip, but leaves and twigs should be removed from the fruit as it is gathered in the orchard.

Sun-drying d'Agen prunes on wooden trays.

Dipping.

Prunes are dipped in a boiling caustic lye to hasten drying. The action of the dip is to remove the coating of wax or bloom from the skin of the fruit and to cause minute cracks. The usual test has been to note a few cracks in the skin near the stem end, the strength of the dip being adjusted for different varieties or even for the same variety when it has been lying on the ground for different periods of time. Over-dipped fruit does not process well, and becomes mushy and unattractive when cooked, while under-dipped fruit dries too slowly. There is a tendency nowadays to use as little caustic soda as possible in the dip.

An initial test may be made by adding sufficient caustic soda (1 lb. to 15 to 20 gallons of water) to cause the appearance of minute cracks after an immersion of two seconds. The strength of the caustic lye is then reduced to a point when the cracking is scarcely perceptible to the naked eye, although the colour change of the fruit should be the same as with the stronger dip. The fruit is placed in dipping baskets, made of quarter-inch wire mesh for preference, immersed to the bottom of the dip and drawn along the length of the dip as it is lifted out to drain. The



Preliminary sun-drying of prunes before transferring to a dehydrator, the chimney of which can be seen in the left foreground.

caustic lye may then be washed off in a clean water bath, but with the weaker dip now used this treatment is not essential. Dipping operations rapidly lower the temperature of the bath, and, if using a weak lye, the temperature of the dip must be watched very carefully and kept as near to the boiling point as possible.

Drying Racks or Trays.

After dipping and draining, the fruit is spread on trays or drying racks. If the weather is very hot some people leave the trays stacked during the first two or three days, claiming that this procedure prevents case-hardening and actually shortens the drying period. Whenever trays are used the fruit should be raked over at frequent intervals, as that portion of the fruit in contact with the tray exudes moisture, which, if not allowed to evaporate, slows down drying and encourages mould development. If the fruit on trays is allowed to lie undisturbed, the skin in contact with the tray either lifts away or remains dull during the final processing of the prunes.

Single tier half-inch netting racks are becoming popular for the sun-drying of prunes. Prunes on such racks dry more slowly than on trays, but, apart from cheapness, rain may fall on such fruit without causing damage. Usually, the prunes are given six to seven days on the rack and finished off by three or four days on trays.

Prunes should be tested for dryness in the cool of the morning, and they should be sufficiently dry to store indefinitely in bulk without fear of mould. When the prunes can be rolled and squeezed without any sign of juice, and show an even meaty condition to the stone, they are sufficiently dry. Over-dried prunes are difficult to process, hence, if the sample varies decidedly in size, the small fruit should not be left out in the sun until the larger are ready to lift. After drying, prunes are sweated in heaps several feet high, for three or four weeks. During this period the fruit should be turned every 10 to fourteen days. Packers do not object to well finished fruit, but consider the general adoption of a finishing dip unnecessary as, when they put the fruit through a similar dip, the ingredients become mixed. They point out that the growers are credited with all the "over-run" which occurs when the packer finally processes the consignment to a definite moisture standard.

Tubercle Free Herds

The following herds have been declared free of tuberculosis under the scheme conducted by the Department of Agriculture. Under this scheme a tuberculosis-free accredited herd of cattle is one in which the entire herd has passed two negative, successive, annual physical examinations and tuberculin tests, or, upon disclosure of infection, three semi-annual, successive physical examinations and tuberculin tests applied by a State Veterinarian or by a qualified and registered veterinarian who is approved by the Chief Veterinary Inspector for that purpose.

ACCREDITED TUBERCLE FREE HERDS.

Herd Number.	Name.	Address.	Number in Herd.	Herd Number.	Name.	Address.	Number in Herd.
1	State Research Farm	Werribee ..	259	6	Lady Talbot Milk Supply Company	Cranbourne ..	418
2	Warragul High School	Warragul ..	35	7	Mailer, Dr. Ramsay ..	"Maneroo," Shepparton	92
3	Payne, A. E. T. ..	"Yarra View," Lilydale	80	8	Reid, Ralph G. ..	"Holmwood," Koo-wee-rup	99
4	Dennis, Mrs. A. A. ..	Frankston ..	14				
5	Slaney, H. B. ..	Mornington ..	85	9	Harris, J. W. ..	"Rowena," Clyde	72

Botulism in Cattle

(*Impaction Paralysis*)

By R. N. Wardle, B.V.Sc., Veterinary Officer.

THE disease, botulism, is referred to also as "para-botulism," and until about twelve years ago was known by the term "impaction paralysis," a name which was a combination of two of the symptoms noticed by stock-owners, veterinarians, and other observers. Our present knowledge leads us to believe that a number of cases of this disease in which death occurred within a few hours of the onset of the illness, thus precluding evidence being gained of the more chronic symptoms, was not recognized as being related to cases of "impaction paralysis."

Nature and Cause.

Botulism is due to a poison or toxin developed by a specific germ or microbe. In Australia the microbe usually associated with this disease is referred to as *Clostridium botulinum* type D. This poison is produced only when the microbes are growing, and multiplying rapidly, and it is interesting to note that only under certain conditions can growth and multiplication take place. The microbe persists in dust, soil, and litter as a spore, and grows only in decomposing vegetable or animal matter in an absence of oxygen.

In some part, at least, of all decaying material, the oxygen content is exhausted by moulds and certain bacteria present; and if the spores of the causal organism be present, they will quickly grow, multiply, and produce their toxin under the most favorable conditions. Later, should conditions be unsuitable, growth of the organisms may cease, but the poison remains in the material. Cattle eating such material are certain to become affected within three to seven days.

The two common sources of the poison by which cattle become affected are, in order of importance—

(1) Bones or other portions of a carcass.
(2) Damaged fodder.

Damaged fodder may occur in one of the following forms—

(1) Mouse damaged hay, chaff, or grain.
(2) Mouldy or musty tops, and butts of stacks.
(3) Winnowed material, left in heaps in paddocks.
(4) Material in the bottom of exposed feed troughs and boxes.
(5) Old rough pastures, long stubble, or blown down crop.

Bone Chewing.

Undoubtedly a predisposing factor in the cause of botulism in cattle is the bone chewing habit, due in almost all cases to the fact that the cattle are getting insufficient quantities of some of the essential mineral elements, namely, calcium and phosphorus.

Cow with Botulism. Note the expression of the head, with protruding paralyzed tongue.

These are present in bones in the form of calcium phosphate, and the animal instinct is such, that in order to make up for the deficiency in the diet, bones are sought for, and are chewed and swallowed.

Symptoms.

It is difficult to state what is the first symptom. Several stock-owners have stated that the first they have noticed is a stiffness in the action of the front legs, but it is probable that earlier than this there would be a difficulty in gathering food, together with a general lassitude and drowsiness. Slobbering at the mouth takes place, and sometimes there is a watery discharge from the nose. Rumination or chewing the cud ceases, the paralysed tongue may protrude from the mouth, and the stiffness in the gait increases to an unsteadiness in walking.

There is naturally a very evident falling away in condition, and this is emphasized by the flattening of the usually well-sprung posterior ribs. The breathing is shallow with no movement of the chest wall, but simply shows as a fluttering of the flank muscles.

Soon the beast can neither eat nor drink, or can drink only with difficulty, and finally it goes down, and is unable to rise.

The average case may linger from three to five days, but more acute cases occur, and with such death may take place in a few hours. The symptoms in these acute cases would be sudden paralysis and coma.

The paralysis most commonly noticed is, of course, that of the muscles of the limbs, but it must be remembered that the muscles used in the acts of gathering food, of swallowing, of stomach and bowel movement, and of breathing are also affected in some degree.

Post-mortem Appearances.

These vary according to the length of the illness. In acute cases, little abnormality will be noticed in the carcass, but if the beast has been drenched, some evidence of the drench having "gone the wrong way," may be seen by its presence, and perhaps even that of some food, in the wind-pipe and bronchial tubes.

In longer-standing cases in which a drench has not been swallowed correctly, there may be a definite pneumonia evidenced by a portion of the lung being solidified, and by the presence of a frothy septic discharge in the bronchial tubes.

In the average case there invariably is a large amount of food present in the paunch; if the beast had not been able to drink for some days, the condition of this food both in the paunch and in the bible is drier than normal, which condition was one of the factors by which the disease was earlier known as impaction paralysis. This so-called impaction is more correctly termed a stagnation of food, and is due to the paralysis of the muscles of the digestive canal. In many cases a piece of bone has been noticed among the paunch contents. Any decaying food that may have been the cause of death would very likely not be recognized even if still present. Often a bolus of food is seen in the back of the mouth, although it may be positively known that no food has been eaten for many hours, or even days.

In cases that have been drenched early in the illness, but which have died subsequently, the intestine, unlike the stomach compartments, contains very little ingesta.

Treatment.

Frequently in cattle a lethal dose of the poison may be swallowed, but on account of the arrangement of the digestive system in ruminants, it is probable that the poison is distributed through the large amount of food held in the paunch, hence absorption of it all may not take place at once, and if it be possible to remove any unabsorbed poison, it is probable that the patient will recover.

It is advisable to administer a small quantity of water, and if this be swallowed, then

Cattle Probang or Stomach Tube, with Gag.

proceed to treat with a purgative drench, such as—

Epsom salts—1 to 1½ lb.
Bicarbonate of soda—4 oz.
Treacle—½ lb.
Water—1 quart.

Every care should be taken, and the drench given slowly. If the patient be unable to swallow, a drench can be given only by artificial aids. There are two means of doing this, which are as follow—

(*a*) Stomach tube.
(*b*) Trochar and canula.

(*a*) As an improvised tube 5 feet of ½-inch hose may be used. To insert, first construct a wooden gag to fit as a bit across the mouth; bore a hole in the centre large enough to take the tubing, and with the gag in place, and the cow's head and neck held straight, pass the tube through the hole in the gag, and over the back of the tongue into the gullet. After it enters the gullet it should be possible to feel it there with the hand, manipulating the left side of the neck just above the wind-pipe.

A length of approximately 4 ft. 6 in. of the hose should be inserted, a funnel attached and the drench poured in.

(*b*) A trochar and canula is inserted into the rumen at the left flank at a point equidistant from the last rib, the point of the hip, and the edge of the loin bones. The trochar is then withdrawn, and the drench poured in through a funnel. Neither of these operations is as easily performed on the recumbent paralyzed beast as on one not so affected, therefore the services of a veterinarian should be obtained, where possible.

If there be no veterinarian in the district, the following further treatment may be given:—

Potassium nitrate	1 oz.
Sodium salicylate	1 oz.
Nux vomica	3 oz.
Ammonium carbonate	4 oz.
Linseed meal	3 oz.

Mix and divide into twelve powders. One powder to be mixed with treacle just before use, and pasted into the mouth three times a day.

To sustain the patient, sloppy and liquid foods, such as gruels and milk, may be given as long as the animal is able to take them.

Prevention and Control.

1. Bone and carcass chewing by cattle should be prevented: all bones and portions of carcasses, including rabbits and birds, should be gathered up and burned or buried. To remedy the craving for minerals which is the cause of the bone chewing, a mineral food supplement should always be available.

The formulae of the non-iodized mixtures recommended by the Department are as follows:—

Boneflour mixture—	
Stock salt	56 lb.
Boneflour	30 lb.
Sulphur	5 lb.
Epsom salts	3 lb.
Sulphate of iron	1 lb.
Molasses	5 lb.
Di-calcic mixture—	
Stock Salt	71 lb.
Di-calcic phosphate	15 lb.
Sulphur	5 lb.
Epsom salts	3 lb.
Sulphate of iron	1 lb.
Molasses	5 lb.

These mixtures may be obtained already mixed or the ingredients may be purchased separately. In the case of the di-calcic mixture the ingredients, except the salt and molasses, may be purchased as a "di-calcic concentrate": to this concentrate three times the amount of salt by weight is added, also 5 lb. of molasses to each 100 lb. of mixture, and the whole is then thoroughly mixed. This forms a convenient and economical method of supplying the mixture in districts where salt is obtainable locally.

The mineral mixture should be placed in troughs or boxes protected from the weather and made available particularly to young cattle and cows. Where cows are being fed three ounces of the mixture may be mixed with the feed. In cases of cattle known to be suffering from a deficiency of lime and phosphate, and where quick response is necessary, the mineral mixture should be mixed into a paste with a further addition of molasses and pasted on to the mouths of the animals with a flat stick: this dosing may be repeated twice a day for several weeks.

2. Fodder damaged by mice, by moulds, or by moisture should not be fed to stock nor should stock be allowed access to such fodder. Special care, therefore, is necessary during

[*Continued on page* 88.

Subterranean Clover

Sowing, Top-dressing, and Harvesting

By J. E. Harrison, B.Agr.Sc., Agrostological Research Officer

The distribution, description and nutritive value of Subterranean Clover were discussed in the December 1936 issue of this Journal.

Soil Requirements.

Subterranean Clover is adapted to a wide range of soils, and its continuous cultivation improves their fertility.

In sandy soils it makes quick germination and growth after favorable autumn rains, and provides feed relatively early and well into the winter. The spring flush is very rapid, but it may be cut short by a dry spell, in which case the yield is severely reduced and the seed becomes badly pinched, making the dry crop less nutritious. In sandy soils the plant easily buries its burrs, perhaps to a depth of 2 inches; and, as rain penetrates such soils very readily, germination takes place quickly after the first autumn rains.

Loams are very suitable and are the most favorable soils. The plant buries its burrs freely, and as rain percolates quickly into loamy ground, these soils allow establishment to take place rapidly after autumn rains, and growth is sustained well into the winter. The crop is not so sensitive to temporary dry spells in spring, and it usually makes heavy growth and fully matures.

Clay loams and clays are not unsuitable, but growth is very tardy on them. Owing to the physical characteristics of such soils, the burrs may not be buried, especially in a dry spring when the soil is hard, with the result that germination is slow in the following autumn and growth is delayed. If the burrs are lying on the surface, it requires a fairly long period of cool moist weather to cause the seed to germinate. Usually, therefore, germination does not occur until late autumn, with the result that the plants remain closely appressed to the ground during the winter. They commence rapid growth later in the spring, but may sustain it longer than on sandy or loamy soils.

Soils which are moist in winter and dry in summer afford the most favorable moisture conditions for growth. Wet soils, of whatever type, retard development, but, if establishment can be secured in autumn when the soil is moist but not wet, the plant is less affected by wet in winter. A heavy clover crop transpires water freely, and may "drain" a soil to a marked extent. It is not uncommon for soils under native or "natural" pasture to be wet and soft in winter, and when established with subterranean clover, to be relatively dry and firm.

Though its adaptation to soils with a high lime content is in doubt, the plant is not very exacting in respect of lime, or in the acid or alkaline reaction of the soil. It has been shown in New South Wales that it grows satisfactorily in soils of varying lime content, and with reactions ranging from very acid to slightly alkaline. The great value of subterranean clover lies as much in its ability, when properly manured, to grow in soils of low or depleted fertility, and improve or restore them, as in its capacity to produce an abundance of nutritious fodder.

Superphosphate.

The response of subterranean clover to superphosphate is very vigorous, and may transform a field from rough grazing into rich pasture within the space of a few years. The plant makes only stunted growth without superphosphate, and if topdressing is not maintained, a stand of clover will steadily weaken with the exhaustion of the "water-soluble" phosphate from the soil.

Research at the Waite Institute, South Australia, has shown that subterranean clover makes a strikingly greater response to a "water-soluble" phosphate than to a "water-insoluble" phosphate. In this experiment single plants were grown in a sand culture containing an adequate supply of all necessary plant nutrients, but one series was supplied with abundant "water-soluble" phosphate, and another series with abundant "water

insoluble" phosphate. The average yields per plant from the two series were as follow :—

Water-soluble phosphate series .. 40·9 grams.
Water-insoluble phosphate series .. 2·29 „

It was discovered further that both series of plants, when chemically analysed, contained approximately the same proportion of phosphates. Apparently subterranean clover is less able than certain other pasture species to vary the amount of phosphorus in its composition. The plants were not only very restricted in their power to avail themselves of the insoluble phosphate, but they were also limited in the use which they could make of any absorbed phosphate in the processes of growth. This was in marked contrast to Wimmera rye grass, which was able both to avail itself of greater amounts of insoluble phosphate and to make good growth with a very limited amount of phosphate in its composition, even to the extent of producing herbage which was deficient in phosphates as a diet for grazing animals.

The report of the experiment states that the fact that Trifolium subterraneum was unable to grow on insoluble phosphate indicates that phosphate in a readily soluble form is necessary for this species. It needs but to add that the phosphate in superphosphate is in this readily soluble form, and the reason for the marked response of the clover to applications of this fertilizer in the field is made plain.

Field trials which have been made in different States have been designed to determine the influence of superphosphate on yield as reflected in increased carrying capacity rather than on hay yields. At the Rutherglen Experiment Farm, Victoria, however, it was found that the yield of herbage from an old clover field was increased with one dressing of superphosphate as follows :—

—	Increase in Year Applied.	Increase in Following Year (Residual Effect).
	%	%
No manure	..	..
Superphosphate, ½ cwt. per acre	44·9	15·0
Superphosphate, 1 cwt. per acre	58·4	24·1
Superphosphate, 1½ cwt. per acre	70·2	50·4

Established clover fields, which are topdressed annually with 56 lb. superphosphate per acre, carry from 2.5 to 3 sheep per acre at the Rutherglen Experiment Farm, while native pastures (unmanured) carry about 1 sheep per acre.

A dense growth of Subterranean Clover and Perennial Rye-Grass on the Mornington Peninsula.

At the Kybybolite Experiment Farm, South Australia, two separate fields, both composed of subterranean clover and annual grasses, have given the following results over a period of years :—

Unmanured, 1.41 sheep per acre ;
90 lb. superphosphate each year, 4.27 sheep per acre—

or a trebling of the carrying capacity.

It is not practicable to graze all the Kybybolite farm fields as completely as the experimental plots, and the grazing from some 200 acres of clover has averaged 2.5 sheep per acre over a period of ten years, while native pastures (unmanured) have carried about 0.6 sheep per acre.

At Crookwell, New South Wales, in a trial conducted by the Department of Agriculture of that State, a field of subterranean clover, topdressed, carried 2.5 sheep per acre, and natural pasture, unmanured, carried 1 sheep per acre. The sheep on the clover cut fleeces from 2 to 3 lb. heavier, and though their wool was somewhat coarser than that from the sheep on natural pasture, it was attractive, well nourished, and of a good length.

Experiment unfortunately has little to say about subterranean clover in relation to dairying, but a lead to its importance is contained in a report by the Kybybolite Experiment Station (which has an average annual rainfall of 20 inches only), that "one of the principal results of our pasture work (with subterranean clover) has been the definite development of ½ sheep per acre land into good dairying country." A herd of milkers uses 90 acres of sown pasture, and produces from 100 to 150 lb. of butter-fat per acre per annum.

These records of grazing from subterranean clover, topdressed with superphosphate, are supported by practical experience in the main pastoral and dairying districts of Victoria. They provide a moderate view of the capacity of the plant and are a dependable guide to the results which may be expected from its cultivation.

Rate of Application of Superphosphate.

Each district of the State seems to have adopted a standard rate of applying superphosphate. The rates are roughly :—

Pastoral belt	90 lb. per acre.
Mixed farming areas ..	112 lb. per acre.
Chiefly dairying areas ..	186 lb. (one bag) per acre.

It is not often that these rates are exceeded in the respective areas; they are, perhaps, more often modified in order that the manure may go further, and with the object also that a better balance may be maintained between the grasses and clovers of a pasture.

Time of Application.

Experience has shown that early applications are best, as growth is then stimulated in autumn and winter, when feed is most needed, as well as in the flush of the season. How early the manure may be applied is largely a practical problem. Pastoralists topdress even in January, when heavy vehicles may be taken on land which would be too wet to carry them in winter. Any deterioration in the superphosphate applied in summer is probably very slight.

The operation of topdressing is carried on in all districts throughout autumn and winter. Late winter growth is probably influenced by applications made not later than June, the influence of later applications being felt mainly in the flush of the season. Late dressings are sometimes given to fields being saved for hay or for seed. This dressing, which may be in addition to an autumn dressing, results in an increase in the spring flush.

Time and Method of Sowing—Preparation of Soil.

It is usual to sow the seed in March and April, although it is frequently sown later. Early sowings, however, usually give better results. In districts of good rainfall the seed may be sown in the spring with reasonable prospects of a successful establishment. It is regarded by many growers in wet districts as better to sow in spring when germination and growth are likely to be rapid than in late autumn or winter, when germination and growth are likely to be slow and the seedlings may fall easy victums to slugs and insect pests.

Probably no other crop or species is sown down in quite so many ways as subterranean clover. The seed (sometimes the burr) is sown on existing pastures, with and without surface cultivation; it is sown with cover crops of oats and other cereals; with rape, millet, cow-grass (perennial red clover), and other fodder crops; and as a constituent of various types of pasture mixtures.

Whatever method is undertaken, there are three simple essentials which normally lead to a good strike and rapid establishment. These are—

(i) the soil surface should be cultivated fairly fine and firm;

(ii) the seed should lie in intimate contact with superphosphate in the soil; and

(iii) seed of high and rapid germinating capacity should be used.

When seed is broadcast on existing pasture without any surface cultivation, establishment is very slow and a good stand may not develop for several years. It is desirable, therefore, that the surface

Establishing Subterranean Clover by surface working and sowing in the one operation.

should be broken in some way, with a pasture harrow, a rigid-tined cultivator, disc cultivator, or any other implement that will break the surface successfully. The seed and manure may then be sown through a drill, or broadcast by hand or machine. It is better to sow through a drill, as seed and manure then lie in intimate contact in the soil. Both operations of breaking the surface soil and sowing seed and manure may be successfully undertaken at the same time with the combined cultivator and drill (the combine) on light soils; and to a lesser extent with a drill only, either the disc or the hoe type. Whatever is done, however, rapid establishment will depend largely upon the success achieved in breaking the surface and in getting the seed and manure in close contact in the soil. A point of some importance is the fact that, if the soil surface is moderately broken only, there is less destruction of perennial native grasses, which may then persist better in the resultant sward.

When an oat crop is sown, it is usual to mix the clover seed and manure, fill the manure box about half full only, so as to minimize the tendency of the seed to separate itself from the manure, and drill in together with the oats in one operation. On heavy soils the clover seed is sometimes drilled in or broadcast separately, with half the manure, after the oats are sown.

When sown in pasture mixtures, the clover seed is usually mixed with the superphosphate and sown through the manure box of a drill, the grass seeds being sown through the seed box. The drill is not a general implement in dairying districts, the seeds and superphosphate often being broadcast by hand, after which the soil is lightly harrowed and rolled to cover the seed.

Where cereal crops are grown it is a very good practice, and one strongly recommended, to sow clover seed with a crop of oats or other cereal before letting land go out to pasture. It results in economy both in the use of clover seed and in the time taken to establish a strong stand of clover. It is a very satisfactory preparation also for the subsequent establishment of perennial grasses, as seed of these can be stubble sown through a drill during the following autumn. In districts of good rainfall, it is usually safe also to sow clover seed with spring sown millet or other fodder crop, and to drill in seed of the perennial grasses without further cultivation in the following autumn. The clover usually persists and sets seed if sown with a spring crop, and the land is brought into very good order for the seeds of perennial grasses if a green crop is fed off during the summer months.

Competition.

In the year of establishment, subterranean clover usually makes headway against all competitors, except perennial rye-grass, which, if thickly sown, may hold the clover in check until the third season. It is not until the rye-grass weakens, apparently owing to a depletion of soil nitrogen, that the clover strengthens and fills the sward. Afterwards there is considerable fluctuation in the proportion of grass to clover, with sometimes a marked alternation of "good clover years" with "good grass years," but, in a general way, a satisfactory balance is maintained.

Rate of Seeding.

There is a marked tendency to increase the rate of seeding beyond the 2 lb. per acre, which has been usual in the past. This seems desirable in districts of good rainfall, where it is important to get high priced land into production quickly. From 4 to 6 lb. seed per acre is frequently sown, with a reduction in the amount of perennial rye-grass seed to 10 lb. and even 5 lb. per acre.

Mixing Seed and Superphosphate—A Warning.

It is generally known that superphosphate has an injurious effect upon certain kinds of seeds if they remain in contact with the manure for a long period. The seeds of subterranean clover suffer injury in this way, though the extent of damage is found to vary from sample to sample. If the risk of extensive damage is to be avoided, the seed and manure should be mixed as required and sown at once. If, as may happen, sowing is delayed for any reason, a fresh lot of seed should be added at about half the normal rate before sowing is carried out.

It is recommended, as a general rule, that the seed should be sown within two hours of having been mixed with the superphosphate.

Spreading Clover on the Farm.

If subterranean clover is established in one field of a farm, it is usually found to spread gradually to other fields, through the agency of stock and through the medium of clover hay that has been fed to stock on unimproved pasture. It is a slow process and one usually left to chance, but the distribution of the burr can be undertaken systematically with better results. It is an easy matter to select the field in which to throw out clover hay and to make sure that the hay is put along a different line each time a load is thrown out, so that a better distribution is made. If, however, the hay has been cut early, at the proper

Showing the Influence of Subterranean Clover and Superphosphate in the Improvement of Native Pasture.

Left—Sub-Clover with Super; Centre—Sub-Clover without Super; Right—Without Sub-Clover and without Super.

time, it will contain very little ripe seed, and will not be a very effective means of spreading the clover. Better results will be obtained by moving stock from a good clover field to outside paddocks during the summer months.

Sheep are regarded as the most effective animals in distributing the burr, apparently because the burr clings to the belly wool when the sheep lie down, and falls off and inoculates other fields with the clover when the sheep are moved. Both cattle and horses are useful also, as much seed passes unharmed through their bodies and when eliminated may begin the establishment of the clover in a new place. Sheep act in the same way also, but to a very small extent.

Pasture Mixtures of Subterranean Clover and Grasses.

Subterranean clover can be sown in combination with perennial rye-grass, Wimmera rye-grass, cocksfoot, Phalaris tuberosa, or Paspalum, according to soil and rainfall. Sometimes two or more grass species are included, but since one grass species may affect another adversely by its competition, it is more usual to sow down one grass species only.

The rate of seeding varies very much, and depends upon rainfall and soil, as well as upon economic factors. The object in sowing less grass seed and more clover seed, which is the general trend in practice, is to secure a dense sward of clover quickly, and since a new pasture first reaches high production through abundant clover growth, it seems sound practice to aim at reaching this stage as soon as possible.

Subterranean clover grows well also in association with various miscellaneous annual grasses, such as barley-grass (*Hordeum murinum*), spear-grass (*Bromus sterilis*), goose-grass (*Bromus mollis*); and hair-grass (*Festuca bromoides*), which usually appear voluntarily on a wide range of soils and under various amounts of rainfall throughout the State. These species increase and flourish with the cultivation of subterranean clover and are readily grazed until they come into ear, when stock neglect them, and considerable waste results because their entire yield of seed is lost owing to the objectionable nature of their seed heads. It is usually observed that these annual grasses are most conspicuous in autumns of light rainfall, which are unfavorable to clover growth. The cause is probably traceable to the differences in root systems, the grasses having fibrous surface roots which would quickly absorb any moisture in the surface soil, and the clover having a taproot which would receive most advantage when soaking rains fell and filled the subsoil with moisture.

The native grass species, Danthonia, may persist in association with subterranean clover if the soil is not unduly disturbed when the clover is sown, and if superphosphate is only moderately applied in subsequent years. A strong stand of clover definitely causes mortality amongst Danthonia plants, and at both the Waite Agricultural Research Institute and the Kybybolite Experiment

Farm, South Australia, it has been shown by experiment that a Danthonia pasture "opens up" as the result of competition from clover and other annual species if these are encouraged with dressings of superphosphate. It was found at Kybybolite, however, that though the number of plants was reduced those that persisted increased in size.

Commercial Seed.

Subterranean clover seed is harvested principally in South Australia, where approximately half of the total Australian seed crop is grown. Western Australia has also become a large producer during the last few years. The estimated average annual production for the Commonwealth is 350 tons, made up as follows:—

South Australia	150	tons
Western Australia	100	,,
Victoria	50	,,
New South Wales	25	,,
Tasmania	25	,,
Total	350	,,

Commercial seed is of variable quality, though usually satisfactory. Samples may be submitted to the Seed Testing Station, Department of Agriculture, Melbourne, C.2, for tests of purity and germination, and both growers and buyers are recommended to take advantage of this service.

In a first-class sample the seeds are well filled and uniform, of a blackish purple colour, bright, glossy, and attractive. A light purple colour denotes that the seed has been wet with heavy rain after the seed had ripened and prior to harvest. The presence of dust on the seed is not always regarded with disfavour, as it is assumed to carry the nitrogen-fixing bacteria which live in association with the clover. If the seed has been harvested from an area infested with lucerne flea, however, the presence of dust and dirt is undesirable, as it increases the probability that the eggs of the lucerne flea are present. Seed may be fumigated by a hydro-vacuum process for the destruction of eggs of the lucerne flea; the treatment is strongly recommended for seed harvested in areas where the lucerne flea is present and for any unknown lines of seed.

The principal impurities likely to be present are barley-grass (*Hordeum murinum*), stork's-bill (*Erodium sp.*), onion-grass (*Romulea cruciata*), knotted clover (*Trifolium striatum*), spear-grass (*Bromus sterilis*), and rye-grass (*Lolium spp.*).

Germination.

An examination of the results obtained with 82 samples germinated at a constant temperature of 20 deg. C. (77 deg. F.) during 1935 gave the following figures:—

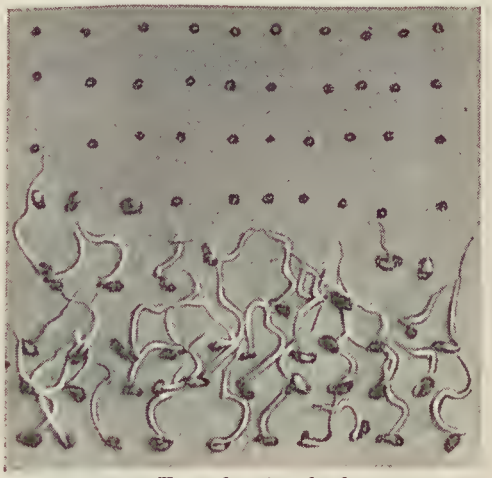
26 samples germinated between 80 to 90 per cent.
23 samples germinated between 70 to 79 per cent.
16 samples germinated between 60 to 69 per cent.
9 samples germinated between 50 to 59 per cent.
5 samples germinated between 40 to 49 per cent.
3 samples germinated between 30 to 39 per cent.

Since "hard" seeds were excluded from the above tests as non-germinable, it is apparent that a "quick" germination of about 80 per cent. should be obtained with a good sample of seed.

Hard Seeds.

Seeds which fail to absorb water when set out under favorable conditions are called "hard" seeds. In the 82 samples examined, the percentages of hard seeds were distributed as follow:—

4 samples contained over 50 per cent. of hard seeds.
6 samples contained from 40 to 49 per cent. of hard seeds.
3 samples contained from 30 to 39 per cent. of hard seeds.
22 samples contained from 20 to 29 per cent. of hard seeds.
27 samples contained from 10 to 19 per cent. of hard seeds.
20 samples contained from 0 to 9 per cent. of hard seeds.



Germination Test showing high proportion of Hard Seeds.

It is known that hard seeds of subterranean clover remain dormant in the soil for some time after sowing. They have no value in the immediate establishment of a crop, and are useful only when the first crop fails to set seed—a rare occurrence.

In order to find out when hard seeds would germinate, a sample known to contain a high proportion was set out in a box of soil and left in the open during May, 1929. A "quick" germination of 28 per cent. occurred, which was approximately the same as obtained in the laboratory. Germinations then took place until the following May as follow:—

Threshing Subterraneaan Clover, South Australia.

Month.	Germination from Hard Seeds.
	%
1929—	
July	0·5
August	0·5
September	1·5
October	2·5
November	2·5
December	2·5
1930—	
January	..
February	27·0
March	1·0
April	..
May	2·0
Total	40·0

Had this seed been used to establish a crop, only the quick germination at the time of sowing would have been important. The hard seeds would have been useful as a "saver" if the first crop had failed, but only in that case. If the first crop had succeeded and set seed, the hard seeds which were sown down would then have had little value in the following season.

Number of Seeds per Pound.

The number of seeds per pound varies from 50,000 to 70,000. If a sample contained 60,000 seeds per pound, then—

1 lb. per acre would give approximately $1\frac{1}{3}$ seeds per square foot.

2 lb. per acre would give approximately $2\frac{2}{3}$ seeds per square foot.

3 lb. per acre would give approximately 4 seeds per square foot.

4 lb. per acre would give approximately $5\frac{1}{3}$ seeds per square foot.

It could reasonably be expected that half the seeds would give rise to plants, i.e., the number of plants per square foot would average half the number of seeds sown. It is apparent, therefore, that 4 lb. per acre is actually only a moderate sowing and might be expected to give rise to an average of $2\frac{1}{2}$ plants per square foot.

Harvesting for Seed.

In South Australia, Victoria, and Western Australia methods of harvesting and threshing seed to suit local requirements have been developed. The work of collecting burr which was held in the straw, lay on the surface of the ground, or was buried in the soil, presented many difficulties; and the task of threshing the burr from straw, sticks, stones, and dust, and finally of hulling the seed from the burr demanded the construction of new types of threshing and hulling machinery. It is a tribute to inventors and manufacturers that clean seed of high germination can be readily placed on the market to-day at a low price.

Fields are usually prepared for harvest by first cultivating and levelling the surface of the ground. The clover is then established and regularly top-dressed each year until a strong stand develops, usually in the year after sowing down. About two cwt. superphosphate per acre is applied in the autumn before a harvest. The clover is moderately grazed until September or October, and then closed altogether or grazed only lightly for the remainder of the year. It is harvested when the crop is dead ripe and the straw is dry and brittle.

At this stage the field is topped with a mower to remove as much straw as possible without any burr. The straw is caught on a carrier behind the cutting bar of the mower, and is forked away as the carrier fills. It is then carted off and stacked for winter feed.

The field is raked with a Campbell rake, an implement with heavy tines clamped together and capable of pulling up runners and burrs. The rakings are dropped into windrows and usually carted in and stacked for threshing at a later date.

The burrs still lying on the surface of the ground are gathered, usually with a horse broom, though sometimes with a road grader. The horse broom is the same kind as used for street sweeping, but it is usual to alter the gear so as to increase the speed of the revolving broom. Hand rakes and hand brooms are rather costly to use. The sweepings contain most of the seed and they are usually threshed first. The South Australian thresher is a special type which removes all sticks, stones, and other heavy rubbish, as well as a great deal of dust, before the material is fed into a peg drum which knocks the burr out of the straw. The burr is then shaken from the straw and conveyed to a special huller and grader which shells and roughly cleans the seed. Various kinds of cleaning and grading machines are subsequently used to prepare the seed for market. The same thresher is used to thresh the seed from the straw gathered by the Campbell rake.

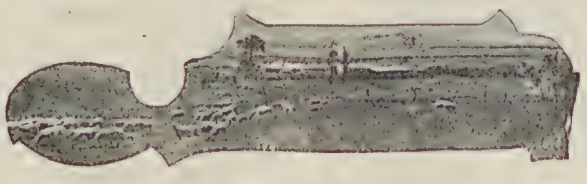
In Victoria harvesting was first undertaken in districts where tufted grasses like perennial ryegrass were growing and made raking and sweeping difficult and even impracticable. A different method of harvesting developed and is still largely used, though other methods could be adopted with advantage in drier districts where the perennial grasses do not persist. The present method is to harvest the crop like a grass hay crop and thresh it with a peg drum thresher to remove the burr from the straw, the burr then being put through a huller to shell the seed. Though several hullers have been invented locally, the South Australian type has been found more suitable.

Wheat harvesters are being used fairly extensively for threshing the crop, which is first mown and then either raked and carted to the harvester, or a "pick-up" attachment is used, by means of which the clover may be gathered and threshed from the swath. The auto-header is preferred if the latter method is adopted. Yields are relatively light if the crop is mown and no sweeping or raking is done, and it is necessary to harvest a large area in order to get any great quantity of seed.

The cheapest method of seed production has been developed in Western Australia, but it appears to be restricted to certain conditions and is apparently more suited to harvesting seed of the early strains. Light soils suit the method best, and care is taken to work the land down to a level surface before establishing the clover. When the crop is dead ripe the straw is burnt off and the land is harrowed to bring the burr to the surface. A wooden roller covered with sheepskin is then used to gather the burr. As the roller runs over the ground the burr sticks to the wool, and is whisked into a carrier behind the roller by means of a cylindrical broom revolving along the top of the roller. It is reported to be an efficient and economical method of harvesting an early strain in Western Australia, but trials in Victoria and Tasmania with later strains are said not to have been very encouraging.

Unless the straw can be got rid of fairly completely by burning, the roller is less efficient and must be run over the ground a number of times in order to collect most of the burr. Very early strains like Dwalganup bury their burr almost entirely and the dead straw can be burnt without injury to the seed, but in Victoria the Mount Barker strain, and more especially the Tallarook strain, carry a great deal of burr in the straw and on the surface of the ground, and a fire cannot be run over a field without destroying much seed.

The burr picked up by the roller is put through a special huller, which shells the seed, and special cleaners and graders are then used to prepare the seed for market.



Lead Arsenate and Lime Sulphur

Analyses of Collected Samples, 1936

By W. C. Robertson, Chemist.

THE provisions of the Fungicides Act (Sections 13 and 14) permit an inspector, who has been appointed under the Act, to enter premises where any fungicide, insecticide vermin destroyer, or weed destroyer is kept for sale. He may examine and withdraw a sample from any of these pest destroyers there found for the purposes of an analysis. The sample is divided into three approximately equal parts, which, after being transferred to suitable labelled containers, are sealed, and certain particulars written on the label. One of the parts so treated is handed to the person in charge of the pest destroyer, the second is retained for future comparison, and the third is utilized for analysis in the departmental laboratory.

All bags or packages containing a pest destroyer, i.e., fungicide, insecticide, vermin or weed destroyer must be labelled and the label must show a registered brand or distinguishing name and must state the proportion per centum of the active constituent contained therein.

An amending Act which became operative on the 1st of April, 1936, had, for its main objectives, provision for the compulsory registration of brands and a general revision of the Principal Act. Permitting the usual three months to elapse prior to enforcing the amendments so that manufacturers and importers would have an opportunity of disposing of or re-conditioning existing stocks held under the Act, active inspection did not take place until towards the end of the year. Stocks of lead arsenate and liquid lime sulphur held in the metropolitan area have been inspected and the results of the analyses are shown in this report.

Lead Arsenate.

Fifteen samples of the different brands of lead arsenate registered were collected during the year, seven of these samples were "wet" (paste) and the remainder in the form of dry powder.

The analyses of the samples, the figures for which are recorded in Table I., show that all but one of the samples comply with the proclaimed standard. In the case of the single exception, this brand of arsenate was withdrawn from sale prior to the sample being taken. The analysis proved the arsenate—an imported powder—to be

The largest works in Australia for producing arsenic (in the oxide form). This raw material, which is essential for the production of all arsenical pest destroyers, is obtained by roasting arsenical gold ore.

somewhat basic in composition with a total content of arsenic ($As_2 O_5$) a little lower than the proclaimed standard. The average analyses of the samples collected are recorded as follows :—

——	Moisture.	Total Arsenic ($As_2 O_5$).	Arsenic Soluble in Water ($As_2 O_5$).	Acidity as Nitric Acid.
	%	%	%	%
Pastes	48·1	32·8	·20	·05
Powders	..	31·98	·29	·07

It can be assumed that the lower average quality of the powder is due to the addition of a "spreader" or "wetter." It is generally recognized that the physical condition of the insecticide in the paste form is superior to that of the powder.

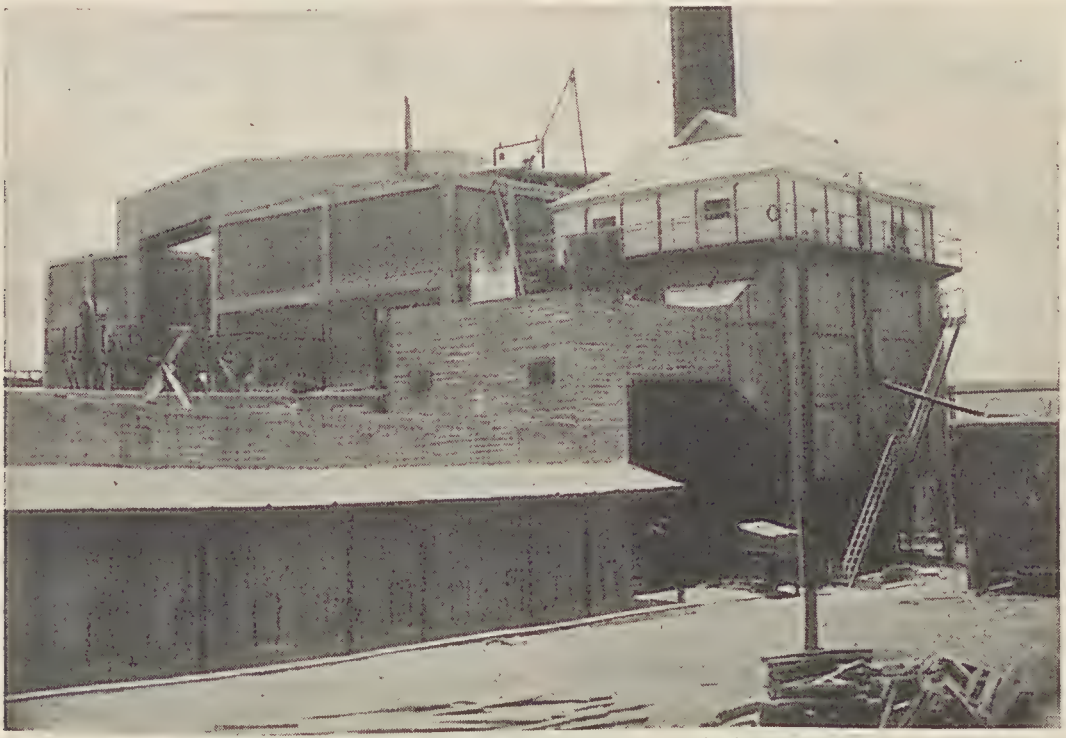
The procedure of estimating the arsenic in suspension in water of the various brands of lead arsenate, after agitating and settling definite quantities, has been discontinued. This is due mainly to the fact that the reduction in acidity, during manufacture of all brands, has definitely evened the power of suspension. Providing, therefore, that the arsenate shows at least 80 per cent. in suspension after trial, it is assumed to be satisfactory as far as degree of division is concerned.

The wettability of the arsenate would appear to be of the greatest importance; because spread is required in the hot months of the year when the sugar begins to collect in the fruit and the pest is most active. At this period the "bloom" of the apple, probably because of the summer heat softening the waxes associated therewith, causes the spray to run into droplets irrespective of the degree of division. Probably the best "wetter" to overcome this natural resistance is white oil, or some substance which would flux

TABLE I.—CHEMICAL ANALYSES OF LEAD ARSENATES.

Brand of Lead Arsenate.	Manufactured in or Imported from—	Moisture.	Calculated on Dry Basis.			Suspension.	Manufacturer or Importer.
			Arsenic ($As_2 O_5$).	Arsenic Soluble in Water ($As_2 O_5$).	Acidity as Nitric Acid.		
Paste.		%	%	%	%		
Bergers	Australia ..	48·2	33·04	·15	·06	Excellent ..	Neptune Oil Co., Bourke-street, Melbourne
Blue Bell	„ ..	47·5	32·84	·13	·01	„ ..	Blyth Chemicals Ltd., Queen-street, Melbourne
Lion	„ ..	46·5	32·45	·43	·04	„ ..	Orchard Sprays Pty. Ltd., Church-street, Burnley, Victoria
Vallo	„ ..	46·0	32·86	·23	·04	„ ..	Victor Leggo and Farmers Ltd., Melbourne
Elephant	„ ..	47·2	33·01	·14	·07	„ ..	Jaques Pty. Ltd., Queen-street, Melbourne
Not branded ..	„ ..	50·5	32·74	·15	·02	Satisfactory	H. C. Sleigh, Collins-street, Melbourne
Aero	„ ..	50·5	32·47	·16	·14	Excellent ..	Ramsay and Treganowan, Latrobe-street, Melbourne
Powder.							
Bergers	Imported ..	..	32·64	·18	·08	Satisfactory	Neptune Oil Co., Bourke-street, Melbourne
Aero	Australia ..	..	31·40	·16	·08	„	Ramsay and Treganowan, Latrobe-street, Melbourne
Arsinette	„ ..	..	31·42	·25	·17	Excellent ..	F. R. Mellor, Elizabeth-street, Melbourne
Plane	„ ..	..	32·45	·12	·03	Satisfactory	N. N. McLean Pty. Ltd., Queen-street, Melbourne
Lunevale	Imported ..	..	33·07	·26	·10	„	D. G. Wills Pty. Ltd., Franklin-street, Melbourne
†Ortho	„ ..	..	30·46	·50	·07	„	H. C. Pannifex and Co. Pty. Ltd., Dudley-street, Melbourne
Summit	„ ..	..	32·03	·55	·03	„	T. E. Butler, Collins-street, Melbourne
Sherwell-Williams ..	„ ..	..	32·41	·29	·04	„	Lawford's Fruit Exchange Doncaster
Proclaimed Standard ..	.. ..	**In the case of paste not more than 50·0**	**Not less than 31·00**	**Not more than ·50**	**Not more than ·20**		

† This brand has been withdrawn from sale.



An electro-precipitating and collection plant by means of which the arsenic ($As_2 O_3$), after volatilisation from the gold ore, is obtained in the form of powder.

with the natural wax. It is suggested that the addition of such a wetter to the paste and powder form of arsenate of lead *during manufacture* may be an improvement.

During the year a single complaint only in connexion with the quality of lead arsenate was received at the laboratory, and in this case the fault partly rested with the orchardist who used a much stronger spray than that recommended. One lot of lead arsenate paste which was inspected and sampled was supplied in unbranded tins. This, of course is contrary to the provisions of the Fungicides Act.

It is of the utmost importance that all packages containing pest destroyers should be correctly labelled and the guarantee of the percentage of active constituent clearly stated therein.

Purchasers need not accept delivery of unlabelled or unbranded parcels.

Lime Sulphur.

Seven samples of concentrated liquid lime sulphur, representing six brands, were collected during the year. The analyses of these samples appear in Table II. and when compared with the figures of the proclaimed standard, which are given at the foot of the table, the quality of the brands represented by the samples must be regarded as satisfactory.

The average analysis of the samples collected is :—

Mono-sulphide Sulphur.	Thio-sulphate Sulphur.	Free Poly-sulphide Sulphur.	Total Soluble Sulphur.
%	%	%	%
5·71	·71	23·29	30·81
(4·72)	(2·61)	(16·75)	(24·71)

The figures show 75·6 per cent. of the total soluble sulphur to be present in the poly-sulphide form, which is now recognized as the most active form of fungicidal sulphur in lime sulphur. The figures in brackets represent the average analysis of the samples collected during the previous year (1935) when 68 per cent. only of the total soluble sulphur was present in the form of poly-sulphide.

These averages are of more than passing interest to orchardists and others who use liquid

TABLE II.—CHEMICAL ANALYSES OF LIME SULPHURS.

Brand of Lime Sulphur.	Mono-sulphide Sulphur.	Thio-sulphate Sulphur.	Free Poly-sulphide Sulphur.	Total Soluble Sulphur.	Manufacturer or Importer.
	%‡	%‡	%‡	%‡	
Elephant	5·72	·76	24·16	31·74	Jaques Pty. Ltd., Queen-street, Melbourne
Blue Bell	5·66	·64	22·88	30·28	Blyth Chemicals Ltd., Queen-street, Melbourne
I.X.L.	5·62	·64	23·68	31·04	Ramsay and Treganowan, Latrobe-street, Melbourne
Neptune	6·84	·38	25·12	33·44	Neptune Oil Co., Bourke-street, Melbourne
Vallo	5·60	·64	21·44	28·78	Victor Leggo and Farmers Ltd., Queen-street, Melbourne
Unity	5·12	1·02	25·28	32·52	T. E. Butler, Collins-street, Melbourne
Blue Bell	5·44	·90	20·48	27·92	Blyth Chemicals Ltd., Queen-street, Melbourne
Proclaimed Standard..	...	**Not more than 2·50**	**Not less than 20·00**	**Not less than 28·00**	

‡ These percentages are in terms of weight in volume.

lime sulphur because of the increased strength in dissolved sulphur and the greater percentage of free poly-sulphide sulphur.

Mono-sulphide sulphur is a necessary compound in liquid lime sulphur because it is the solvent for free sulphur in the formation of poly-sulphide sulphur and on its percentage depends the percentage of poly-sulphide. On the other hand the thio-sulphate sulphur is an oxidation product, which, if not deleterious, is comparatively ineffective and consequently the percentage present in the fungicide should be controlled.

It will be observed that, in the average figures computed from the analyses of the lime sulphur samples examined during the past two years, not only has the poly-sulphide content increased, but the percentage of thio-sulphate sulphur also has markedly decreased, even although the total percentage of sulphur dissolved is considerably greater. This means increased efficiency, for the purchaser now receives more soluble sulphur, more effective sulphur and less ineffective sulphur per gallon of the spray or fungicide purchased. However, there appears to be some trouble in stabilizing the quality of concentrated lime sulphur because the analyses of the samples collected (see Table II.) are decidedly irregular.

Complaints were received during the season that crystals were separating out in some of the concentrated lime sulphur containers. These crystals proved to be poly-sulphide of calcium, and wherever crystallization took place a consequential reduction in the strength of the original solution or spray would occur. If the crystals were thrown aside and not re-dissolved a definite monetary loss would ensue apart from the fact that a weakening in spray strength may be followed by poorer pest control. The formation of the crystals may have been due to faulty manufacture or to the concentration by the evaporating of previous seasons' stocks; in any case it is a fault which must be remedied.

It would appear that the existing standard for lime sulphur in Victoria, viz. :—20 per cent. free poly-sulphide sulphur, and 28 per cent. total soluble sulphur is probably the limit to stableness in concentrated liquid lime sulphur, particularly as samples of English manufacture show approximately 20 per cent. poly-sulphide sulphur with a total of 25 per cent. soluble sulphur.

It is hoped that inspections during 1937 will be more extensive and will permit a more thorough examination of stocks of the various brands of lime sulphur with the object of obtaining data as to any variability in composition.

Botulism in Cattle *(continued from page 76.)*

mouse plague periods and the season of summer and autumn rains.

The number of cases of botulism in cattle has decreased to a remarkable degree in Victoria of recent years. Undoubtedly this fact is due to the spread of knowledge of the cause of the disease and the methods by which it may be prevented and controlled.

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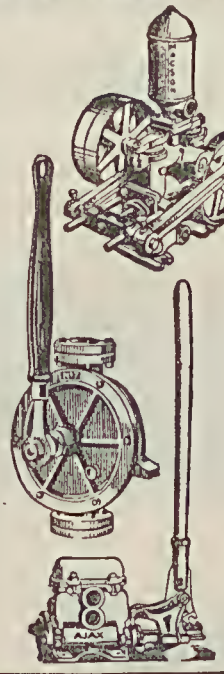

The "Macson" (*top illustration*) is a powerful double-acting Piston Pump, that will pump up to 100 lbs. pressure or 250 ft. elevation. A fine pump for irrigation or general water supply. Sizes range from 1¼ to 3 inches, with prices from £15 to £48.

"Rota" Semi-Rotary Pump (Centre) This is a medium-capacity pump which is specially suitable for pumping oils and petrol. All the inner working parts are of brass. Sizes from ⅛ to 2 inch. Prices from 25/- to 97/6.

"Ajax" Double-acting Low Down Lift and Force Hand Pump (*lower illustration*). The long handle and cog-gear give great leverage and reduce power required to operate. For general pumping, spraying, irrigation. Size 1¼ inch. Capacity 500 gallons per hour. Price £3/17/6.

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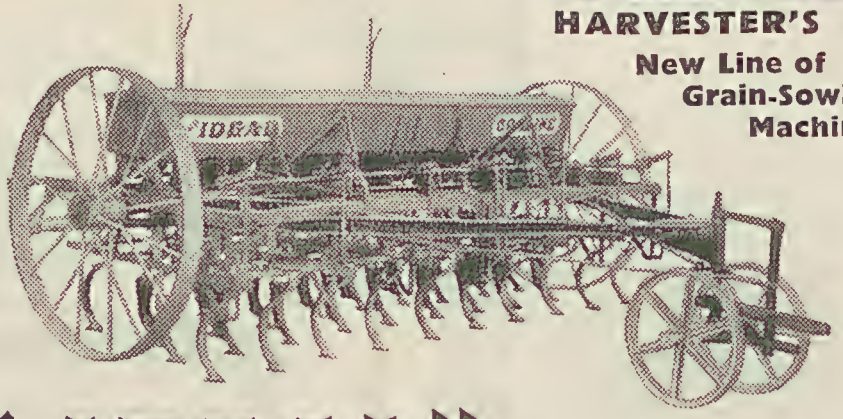

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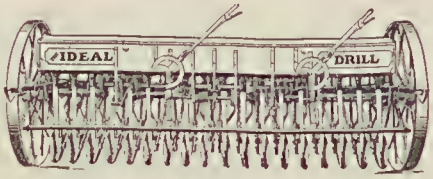

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Dairy Production

Imperial Economic Committee's Review

THE continued expansion of milk production, which has meant a greater relative increase in the output of milk products, chiefly butter, is revealed in a report just issued by the Imperial Economic Committee (Dairy Produce: A summary of figures of production and trade relating to butter, cheese, preserved milk, eggs, and egg products, price 2s. 6d.). Since 1929, the cow population in most countries has been increasing, although in many there has been a decline in total cattle during this period. More important than cow numbers, however, has been the increased productivity per cow.

Butter consumption has, with few exceptions, continued to rise, and in the United Kingdom the increase in the past six years has been equivalent to 7½ lb. per head. The greatest increases have occurred in those countries where margarine consumption is a factor and have been partly at the latter's expense, e.g., in the United Kingdom and Denmark, countries also in which the full effect of low prices was felt. The increasing consumption was checked in some countries in 1935. Apparent butter consumption is particularly high in Empire countries and greatest in New Zealand and the Irish Free State with over 40 lb. each per head per annum. Consumption in the United Kingdom is equivalent to about 25 lb. per head, in United States of America to about 18 lb., and in Germany and France to about 16 lb. and 12 lb. per head respectively. Cheese consumption also appears to have increased during the period under review. Empire countries do not figure as large consumers of cheese; the United Kingdom comes at the top with a consumption equal to about 9 lb. per head, or two and a half times that of Australia or Canada. European countries show a larger *per caput* consumption, equal to about 12 to 13 lb. in Germany, 11 lb. in France, and about 18 lb. in Switzerland.

World trade in butter continued to increase between 1929 and 1935, due largely to shipments from Empire countries. Exports from foreign countries, chiefly European, have declined. These exports had reached a peak in 1931 and the subsequent decline may be traced to low prices and increased tariffs and restrictions in importing countries. Re-organization of and assistance to the dairy industry has, however, apparently reversed the downward trend in the case of some exporting countries in the past year or two.

The United Kingdom is the world's chief butter importer and its share of world trade has risen from less than two-thirds of the total in 1929, to over four-fifths in 1935. Actual imports into the United Kingdom increased by 50 per cent. in these seven years and the quantity received from Empire countries more than doubled. Imports into other countries have declined, chiefly as a result of restrictive measures.

International trade in cheese declined by about 21 per cent. between 1929 and 1935, and preliminary figures suggest that the downward trend has continued during 1936. Empire shipments were fairly well maintained from 1929 to 1934, but a reduction in 1935 brought last year's figure 11 per cent. below that of 1929. New Zealand is the chief exporting country. Although imports of cheese into the United Kingdom declined between 1929 and 1935, the proportion of world exports taken by that country has grown to over half of the total. Nearly 90 per cent. of United Kingdom imports are of Empire origin.

Total world exports of eggs were reduced by about 35 per cent. between 1929 and 1935, although the declining tendency appears to have been checked in 1936. A drop of 20 per cent. in imports into the United Kingdom between 1929 and 1935 was less severe than that of other importing countries, and that country's share of world imports rose from under two-fifths of the total to nearly one-half during the period. Empire supplies, which account for about one-quarter of United Kingdom imports, had been fairly well maintained up to 1934, while foreign supplies were severely reduced, but a reversal of this trend occurred in 1935. *Per caput* consumption of eggs is high in Canada, where it averages about 270 annually; the United

States consume about 250 eggs per head yearly, the United Kingdom 150, and Germany nearer 100.

Dairy products resisted the depression rather longer than many other farm commodities, but prices declined until 1934, by which time they had fallen more than agricultural products in general. Between 1929 and 1934, New Zealand butter decreased in price by 58 per cent., and Danish butter by 46 per cent., while cheese was reduced on the average by about 50 per cent. A marked recovery took place in 1935 and for both butter and cheese the advance has continued during 1936. The fall in egg prices was apparently less severe than in dairy products, while during the current year quotations have been well above the 1935 average.

Butter Production and Export

The following table shows:—

(*a*) Factory production of butter and cheese in Victoria for the period July to November 1936, compared with the corresponding period of 1935; and

(*b*) Quantities and percentages of various grades of bulk butter examined in Victoria from 1st July to 26th December, 1936, in comparison with the corresponding period of 1935.

FACTORY PRODUCTION OF BUTTER AND CHEESE IN VICTORIA (QUANTITIES IN TONS).

Month.	Butter.		Cheese.	
	1936.	1935.	1936.	1935.
July and August	5,986	7,404	614	652
September	6,688†	6,159	526	504
October	8,905†	9,309	707†	689
November	9,933†	10,136	830†	681
Totals, 5 months	31,512	33,008	2,677	2,526

† Subject to revision

BULK BUTTER EXAMINED FOR EXPORT IN VICTORIA (QUANTITIES IN TONS).

Period.	1936. How Graded—				Total.	Period—	1935. How Graded—				Total.
	Ch.	1st.	2nd.	Pty.			Ch.	1st.	2nd.	Pty.	
1st July to 28th November ..	12,005	4,189	958	101	17,253	1st July to 30th November ..	13,509	5,958	1,221	116	20,804
29th November to 26th December	4,244	1,295	390	54	5,983	1st December to 28th December	3,613	1,917	486	84	6,100
Totals 1st July to 26th December	16,249	5,484	1,348	155	23,236	Totals 1st July to 28th December	17,122	7,875	1,707	200	26,904
Percentages ..	69·9	23·6	5·8	0·7	..	Percentages ..	63·6	29.3	6·3	0·8	..

Irrigation Water

Its Use and Misuse

By L. C. Bartels, B.Agr.Sc., Senior Agrostologist.

VICTORIA is a fertile and well favoured state, but in many portions—particularly in the north and north-west—the rainfall is inadequate for bountiful pasture and crop production. Dry seasons occur at intervals and, in the past, the extension of settlement to the drier parts was a hazardous undertaking.

Early in the history of settlement the need for water conservation was great, but there is an altered situation to-day. Through the work of the State Rivers and Water Supply Commission during the past 30 years, water storages (including half the capacity of the Hume Weir) which hold 2,000,000 acre feet of water exist in Victoria, and the water from these is distributed over 15,000,000 acres mainly for stock and domestic supply. Two million acres is served with water for irrigation purposes and some 500,000 acres is irrigated every year. About 85,000 acres of that total is represented by vineyards, orchards, and areas of miscellaneous crops, while the remainder includes agricultural and pastoral areas where dairying and sheep husbandry are the main activities.

A variety of fodder crops is grown, but the water is used mainly to irrigate natural and sown pastures, lucerne, and cereal crops. If properly used, this great utility will confer lasting benefits on the state; misused, the water may merely hasten the depletion of soil fertility—a disaster which must be averted.

Evidence of the benefits of irrigation is not wanting, and in every district there are settlers who have brought their farms to a condition of fertility and productivity which could not have been anticipated. At the same time, it must be said emphatically that, over the greater part of the irrigation area, water is not being used to best advantage.

The aim of every irrigator should be to use water efficiently. That means, first, that he should apply the water to the land surface as uniformly as practicable; and, secondly, that he apply it in the manner calculated to induce

Sheep grazing on irrigated pastures at the State Research Farm, Werribee.

Cutting lucerne for hay in the Bacchus Marsh district.

high and sustained production of good quality crops without waste of water and without damage to land. It soon becomes obvious in practice that, to attain the first objective, land must be graded; distributing channels must be placed with due regard to slopes and, depending on the character of the land and its contours, a system of furrows or checkbanks must be laid down to direct the flow of water. The border method of irrigation with the land divided into rectangular sections, by low banks, is the one recommended for general use. To the second objective, the irrigator should be guided by a knowledge of the water requirements of his crops, of the effect of varying rates and frequencies of watering on yields and character of crops, also cumulative effects of particular practices.

Investigations at the State Research Farm, Werribee, have yielded information for the guidance of irrigation farmers. Experiments on lucerne with varying rates and frequencies of watering have established that, in a normal season, two feet of water in addition to rainfall is required for best growth of that crop. When one refers to best growth one should have regard to all circumstances—the best return per unit of water, the best quality of fodder, the maintenance of the stand for the longest period, and the avoidance of any deleterious effects on the soil.

It is obvious that, if lucerne be kept growing without check through dry periods, best results will accrue; this involves regular watering, and it must be emphasized that two feet of water applied in six 4-inch waterings has proved of much better value than the same quantity in four waterings distributed over the same period. A foot of irrigation water or even eighteen inches of water distributed through the season was inadequate at Werribee and failed to maintain the lucerne in a fresh and vigorously growing condition.

Extra water, even up to four feet in the year, increased the yield of lucerne for a year or two, but it induced a coarse growth, and the stand began to thin out; the weakened plants became susceptible to parasites such as eel-worm, and the yield declined. Although increasing quantities of water improved the yield, the extra yields were not proportional to the extra water.

The farmer may say in answer to all this, "How are we to get into the soil the right quantity of water?" One may say, "I water my lucerne when the water is available to me in turn—it responds, but in a week it is showing evidence of the need for more water—the foliage is dark green and it comes into flower while stunted, and although I water again as soon as I can, the stunted lucerne does not continue growth, but new shoots appear." Now, that

was just the condition that obtained when the waterings were restricted to two inches in the Werribee tests, but when, by supplementary waterings, a 2-inch watering was made a 3-inch watering, and six such waterings were given through the season, the yield was doubled and a further supplementary irrigation, making 4-inch waterings, gave the best results of all.

The difficulty of getting the right quantity of water into the clay loam soils of the Goulburn Valley, for example, is a very real one, and the best results are obtained by a system of supplementary waterings. A day or two after the first application, and while the water is still available, the land may be watered again. If this is done regularly, progressively better results will acrue without much additional labour. This advice, however, is not for him who has not graded his land; on badly graded land this supplementary watering will aggravate drainage problems.

One of the most remarkable results from liberal top-dressing with superphosphate was the influence it had on the permeability of tight land. At Tongala, it was found that the soil underlying irrigated but unmanured lucerne was very dry and the lucerne roots did not penetrate far, but a very great difference was apparent in a plot receiving 4 cwt. of superphosphate, which adjoined the first and was irrigated in precisely the same manner. On it the land was moist to a great depth, and the roots penetrated deeply with a corresponding vigour of growth above.

With lucerne, the careless irrigator usually learns to his cost that the stand must be carefully irrigated, but, on some areas where soils are deep, excessive watering is merely wasteful till the waste water brings a water table near to the surface. If the land is salty, the trouble is intensified because it leads to a concentration of salt at the surface and the soil becomes sterile.

"Irrigated Pastures," is a familiar term now, and, definitely, pastures are the most important crop grown under irrigation in Victoria. But pastures include everything from natural unimproved pastures to the luxuriant mixtures of perennial rye-grass, white clover, and cocksfoot, which are a feature of many of the farms in the irrigation closer settlement areas in the north as well as the southern parts of the state. Because of their varied character, pastures are very flexible, and irrigation methods govern yield, composition, continuity of growth, and longevity.

Pastures withstand abuses in irrigation and some pasture elements flourish in places where lucerne would be drowned out, but despite a general impression to the contrary, the best growth of pastures, the best balance of species, and the best distribution of growth are achieved when two feet of irrigation water is applied, and that in six 4-inch waterings. In other words, the requirements of both lucerne and pastures for best results are similar. There is one essential difference between the two crops. Lucerne will withstand neglect to water even in low rainfall areas, but not so mixed pastures, and such desirable elements as white clover would simply die out if watering were neglected too long. In many of the irrigation districts, the authorities could not guarantee to make water available at sufficiently frequent intervals to grow the best mixed pastures; in such circumstances the choice of species should be confined to such plants as lucerne, rye-grass, and subterranean clover.

In all departmental tests, the paramount importance of top-dressing irrigated lucerne and pastures has been demonstrated, and carefully conducted experiments have shown that an annual dressing of 4 cwt. of superphosphate per acre is a payable proposition. In this article some of the considerations which should guide irrigators in the use of water have been indicated—they are supported by the experiences and practices of many successful irrigators which are an exposition of departmental teachings.

Carting lucerne hay.

The security which an abundant supply of water and a good distributary system give the irrigated areas and the state would be nullified if these benefits were to be limited in duration. Unhappily, many farmers are so short-sighted as to grasp the immediate benefits of irrigation while using methods that lead to land spoiling.

Irrigated Pastures—Rotational Grazing

Yield Sampling and Botanical Analysis

By E. T. Beruldsen, B.Sc. (Agric.), Senior Irrigation Officer, and A. Morgan, B.Agr.Sc., Irrigation Field Officer

IN November, 1929, a Rotational Grazing Trial was commenced at the State Research Farm, Werribee. The lay-out of the experimental area has been described, and the live weight increases, wool production, carrying capacity, and general economy have been discussed in a previous issue of this *Journal* (1). The pasture was sown down in 1916, and the component species are perennial rye grass, cocksfoot, Kentucky blue-grass, and white, strawberry, and subterranean clovers. *Poa annua* is plentiful in winter. Prior to the commencement of the experiment, the field had been subjected to grazing by all classes of farm stock, and a very good dense sward was present.

Briefly, ten acres of pasture is grazed under two systems, two 2½-acre sections being grazed alternately every 10 days, while ten ½-acre sections are grazed in rotation for two days and rested eighteen days. To obviate the difficulty of fouling, daily changes on the ½-acre plot system were adopted during most of the period dealt with here. It became apparent that much useful information, apart from the recording of live weight increases, &c., could be obtained by making periodical botanical surveys and by yield-sampling, with a view to determining the amount and quality of the herbage eaten and the relative palatability of the component species of the sward (2).

While these measurements of herbage production and botanical composition were being carried out—December, 1930, to October, 1932—dry sheep were on the plots. Crossbred wethers were grazed till 1st April, 1931, when a line of ewe weaners was introduced. The latter remained unmated on the plots till December, 1932. The live weights were recorded at ten-day intervals, and the numbers carried, varying from eleven to twenty per acre, were adjusted from time to time according to the amount of feed apparent and the progress live weights.

Each year the pasture received 2 cwt. of superphosphate per acre, applied in autumn, and the irrigations were applied on the "watered-as-required" basis, nine waterings of approximately 2 inches being given during the season 1931–32. The incidence of the rainfall was somewhat

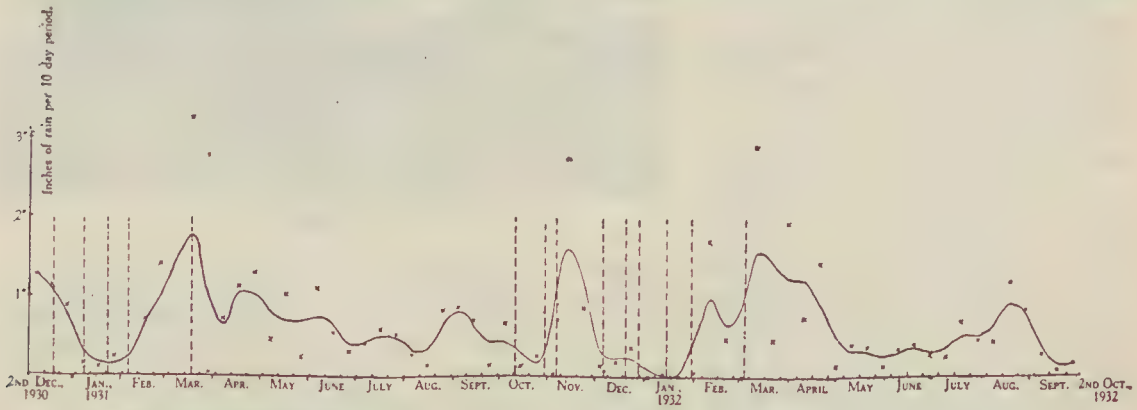

Fig. 1.—Showing rainfall and incidence of irrigations for the period 2nd Dec., 1930, to 2nd Oct., 1932.

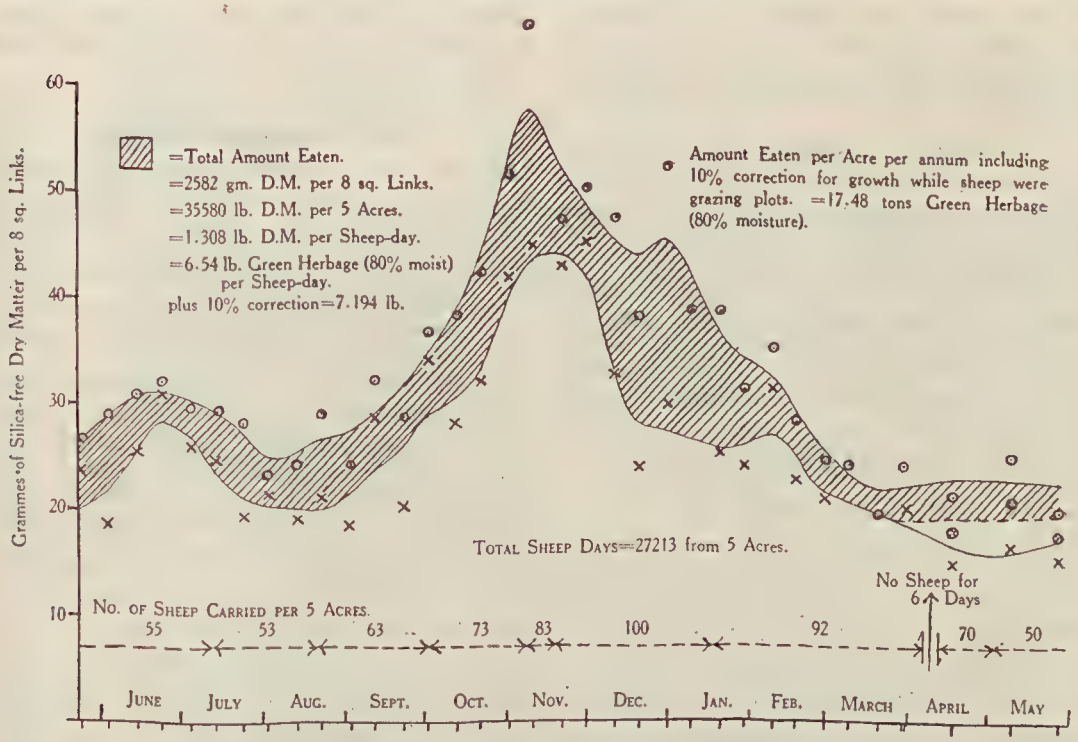

Fig. 2.—Showing the amount of herbage eaten per day, together with the variation in stocking, for the period 24th May, 1931, to 27th May, 1932.

abnormal during this season, and while waterings were only one week to two weeks apart in the mid-summer period, they had to be curtailed in the autumn on account of exceptionally heavy rain. This is illustrated in Fig. 1.

Carrying Capacity.

During the period 24th May, 1931 to 27th May, 1932, eleven to twenty sheep per acre were carried for a total of 5,443 sheep-days per acre, or 14.8 sheep per acre per annum. Their average live weight at the commencement of the tests was 64 lb., while at the end of the period it had reached 113 lb., giving an average live weight, for the whole period, of 89 lb. The variation in the number of sheep carried is indicated in Fig. 2.

The principle guiding the stocking was to put on sufficient sheep to complete the grazing of the pasture in the specified time. Although due regard was paid to the progress of the sheep as regards live weight, the first consideration was the pasture, and this policy was sometimes detrimental to the grazing animal, and also to a determination of the normal appetite of the sheep.

Live-Weight Increases.

The total live weight increase per acre from 22nd May, 1931, to 21st May, 1932, was 563 lb. This was the smallest amount recorded per annum during the six years of the test. As previously stated, during this year the rotation period was shortened from twenty to ten days, and the lower live weight increase is in accordance with the results of the Frequency of Cutting Test (5), in which it was found that short intervals between cuts considerably reduced total production of herbage.

The mean gain or loss per sheep per day is shown in Fig. 3. The highest live weight gains per sheep per day were made in the spring and summer, while losses were made during June and July. The loss during March and April, 1932, is an unusual feature, due mainly to the cold and wet weather, and will be discussed later.

Although not strictly relevant to the discussion of the results of yield-sampling, it is important to note the live weight increases per acre for the six months period including winter, during four years of the tests (Fig. 4). In 1930 and 1932, dry sheep were on the plots, while in 1934

and 1935, grazing was carried out by pregnant ewes. These years have been chosen because the minimum stocking in each instance was eight sheep per acre and the rotation period was twenty days.

From the middle of May to the middle of July, 1930, the wethers lost considerable weight. During the same period in 1932, the dry ewes did little better than maintain their live weight. The pregnant ewes, on the other hand, made appreciable gains in live weight during the same periods. From the point at which lambing commenced, the graphs represent the live weight increase of ewe *plus* lamb. In 1934, lambing commenced three to four weeks earlier than in 1935. In 1934, for a short period after lambing commenced, the lamb weights and increases did not compensate for the ewes' loss at parturition and while nursing lambs during July.

In 1935, the mating of the ewes was postponed till the end of February and lambing did not commence till the end of July, just prior to the commencement of the spring flush period. In this year the rapid increase in aggregate live weight of the lambs soon compensated for the ewes' loss at parturition, and the ewes themselves made very little further loss after parturition. It appears to be an important factor in the breeding of fat lambs on irrigated pasture of *perennial* species to mate the ewes at such a time as to have the lambing commencing just prior to the spring flush period. In 1935, the lambs progressed so well that the first draft of lambs was sold at an average age of fourteen weeks and an average live weight of 70 lb.

Yield-Sampling Method.

Based on a uniformity trial carried out on a ½-acre plot, a method of yield-sampling and botanical survey was proposed in January, 1931 (2), and was put into operation as soon as the necessary equipment was made available. Its use in an experiment where watering-test plots were grazed instead of being motor-mowed, has been reported (4).

Briefly, on a ½-acre plot, 25 samples, each eight square links in area were cut to ground-level before grazing, and 35 similar samples were cut after grazing, using a hand-operated shearing machine. The samples were distributed on an organized scatter, but each was taken at random within an area of 100 square feet. Several scatters of similar pattern were possible on the ½-acre, and by recording and changing the scatter at each sampling, the possibility of any eight square links being sampled twice was removed. The necessity for this precaution arose from the drastic effect, on subsequent growth of grasses particularly, of clipping to ground-level.

The clippings were collected by hand, as no satisfactory automatic collecting device could be arranged for, and a percentage loss was unavoidable: this loss was, relatively, more

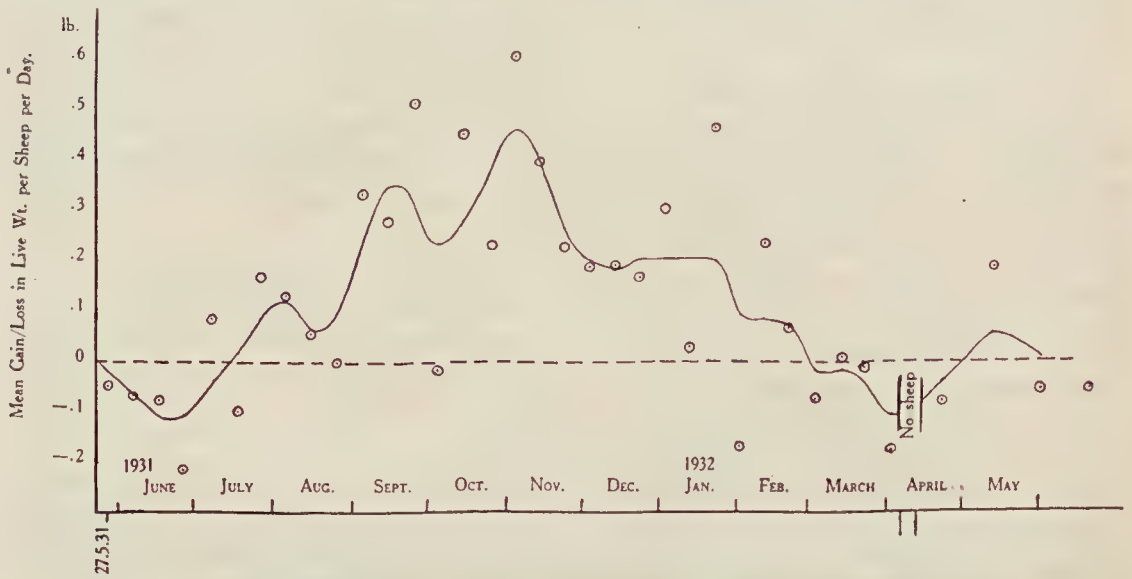

Fig. 3.—Showing the mean gain or loss in live weight per sheep per day.

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important with short leafy herbage than with longer, stemmy herbage, and to reduce it to a minimum meant the collection of a considerable percentage of foreign material in the form of droppings and soil. The clippings from each sampling were composited, dried in a large electrically-heated oven, and bagged for cleaning.

Attempts to reduce the amount of hand-cleaning by sieving, using a blower activated by an electric fan, and so on, were fairly successful, but further reduction of the work involved by using sub-sampling was found impracticable. The cleaned dry clippings were weighed, and sampled by quartering for chemical analysis at the State Laboratories under the direction of the Agricultural Research Chemist (Mr. W. R. Jewell). The time occupied in cleaning the herbage, and then in chemical analysis, was extended, and the calculations involved on receipt of the results further delayed the preparation of this report. The results have shown that the quartering method of sampling for chemical analysis of the clippings is subject to the same disability, though to a lesser degree, as is sub-sampling to reduce the amount of cleaning necessary. In future work along these lines it will be essential to chaff or grind the composited clippings before sampling for chemical analysis, and to retain the bulk of the material until the chemical analysis is completed and shows no abnormal features (particularly in regard to silica). In addition, a more efficient drying oven is required to deal with a larger number of samplings than could be coped with in this experiment, and it is essential to make this work a full-time programme for a single investigator, on plots where the maintenance of high carrying capacity is not the main objective.

Another source of error in yield-sampling by this method, it is considered, is the practical difficulty of cutting to the same "ground-level" when clipping the samples, particularly in wet weather, and it would appear that there is a tendency to cut to a lower level when sampling "after grazing." However, any technique of this type requires a considerable period for its perfection, and, despite the errors involved, the method has provided useful information which is in line with results obtained elsewhere by other methods. Provided the above points are kept in mind in future work, yield-sampling in addition to grazing, appears still to be a most valuable method of investigation of pasture problems.

The early attempts at yield-sampling embraced the 2½-acre plot system as well as the ½-acre plot system, but the former was discontinued because of difficulties encountered in cutting and cleaning the herbage which grew on the sampled areas during the ten days grazing period. Also, it was impracticable to protect the sample areas from the sheep.

The procedure developed into yield-sampling and botanical survey of two or three ½-acre plots each rotation period of twenty days. Then when the rotation period was shortened to ten

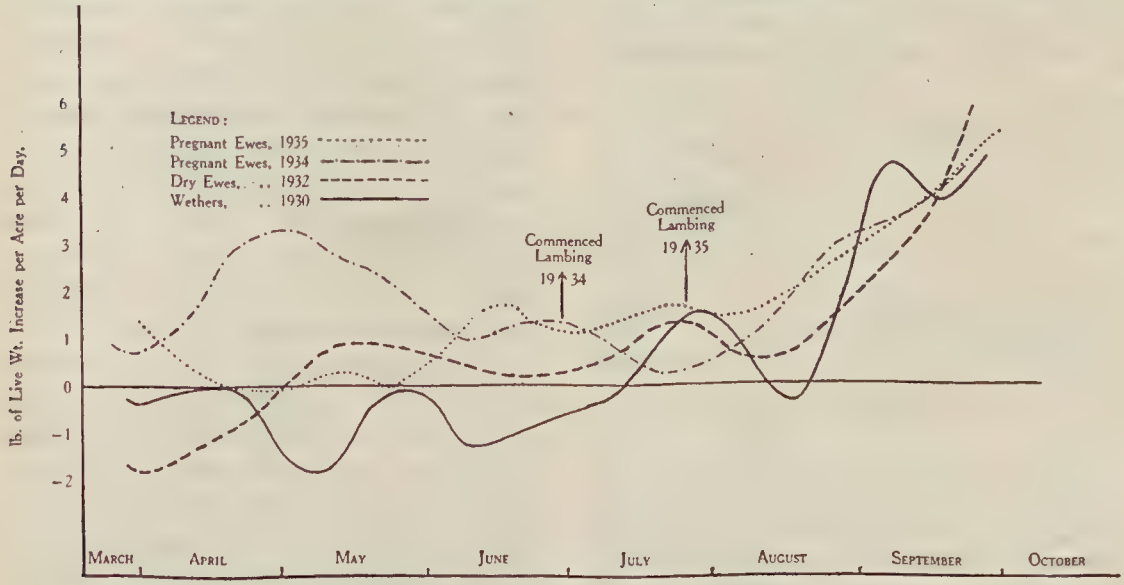

Fig. 4.—Pounds of live weight increases per acre per day for the same six-monthly periods during four years of the tests.

days, only one section was sampled at each rotation. Excluding two sections at the bottom of the field, where excess water occasionally lay in patches, each section was estimated in turn as far as weather conditions permitted. To provide regular continuity of yield results, two adjacent and comparable ½-acre sections were yield-sampled alternately at each rotation without being botanically surveyed. The estimated percentage productivity method was used (3) (9) for botanical surveys, 35 samples of four square links on a scatter identical with that described for yield-sampling being estimated before and after grazing.

Total Amount Eaten by Sheep.

The total amount eaten by the sheep is shown graphically in Fig. 2. The individual sampling results show considerable variation, for reasons discussed later. The area between the smoothed graphs of the amounts present before and after grazing represents approximately the amount eaten by the sheep during the year. The area represents an amount of 15·9 (approximate) tons per acre of green herbage (80 per cent. moisture) eaten by the sheep, and with a 10 per cent. correction for growth occurring during grazing gives a total of approximately 17½ tons per acre consumed. This result agrees with that obtained by motor-mowing an irrigated pasture treated in a similar manner in regard to water and manure (5) (see Table I.). It is important to note that at no time did the sheep eat more than a fraction of the amount available.

TABLE I.—COMPARISON OF YIELD OF CLIPPINGS AND AMOUNT EATEN BY SHEEP.

Plot.	Yield of Green Herbage (80 per cent. moisture.)
Motor-mown every seven days (Frequency of Cutting Test) ..	16·7 tons per acre
Grazed every ten days (Rotational Grazing Trial)	17½ tons per acre
Motor-mown every fourteen days (Frequency of Cutting Test) ..	18·3 tons per acre

The amount eaten by the sheep at any time is of little value in determining the growth rate at that time, since the former varies with the number of stock carried, and obviously there is a lag between growth and utilization by the sheep.

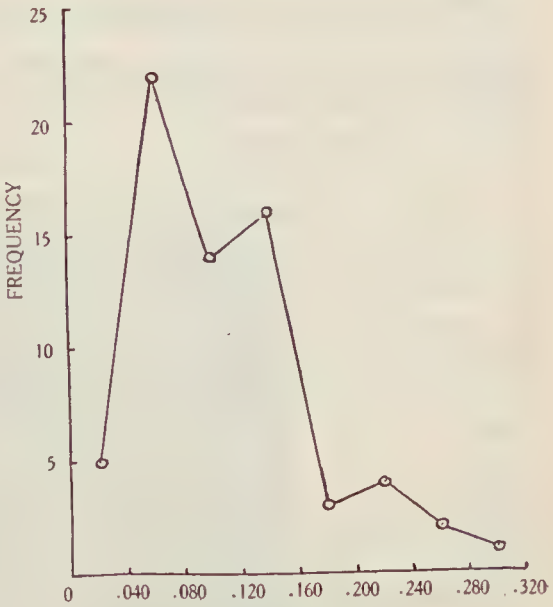

Fig. 5.—Determination of the amount eaten per sheep per day, by means of the frequency polygon.

Amount of Green Herbage Eaten.

As determined from Fig. 2, the total amount of green herbage (80 per cent. moisture) eaten was approximately 17½ tons, representing an average of 7·2 (approximate) lb. per sheep per day. An alternative method is to use the frequency polygon (Fig. 5) to determine the mean "amount eaten per sheep per day." This method gives a figure of 7·80 lb. per sheep per day. This last figure includes results from those plots which were botanically surveyed.

These figures are low compared with those obtained by other investigators. Cockayne (6) gives 24 lb. of green grass as the average consumption per sheep per day. Stapledon and Jones (7) record that in five days grazing in 1925, in early summer, sheep of an average live weight of 122 lb. consumed an average of 11·3 lb. of green herbage per day, and on repetition of the test in 1926, with sheep of average live weight 130 and 137 lb., the consumption, in summer, was 11·3 lb. and 14·8 lb. per day respectively. These latter figures are the averages for six days and eleven days grazing. According to Fig. 6, the maximum consumption per head per day, inclusive of a 10 per cent. correction for growth during the grazing period, was approximately 13 lb. of green herbage, and at one sampling an average consumption of 22 lb. per sheep per

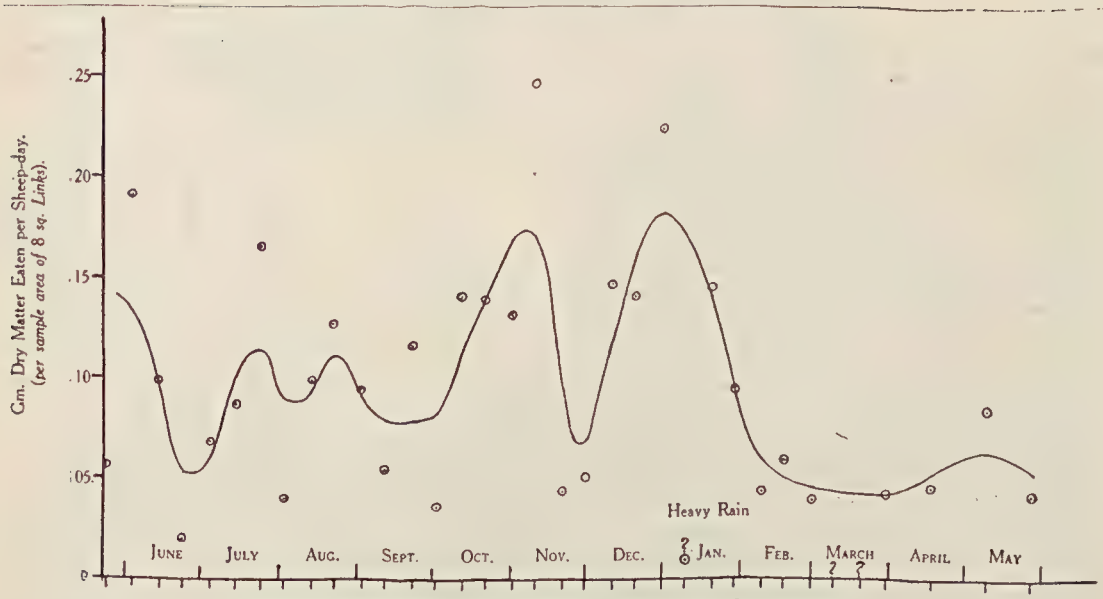

Fig. 6.—Showing the amounts eaten per sheep-day.

day was recorded. The minimum amount eaten per day, according to Fig. 6, was approximately 3½ lb. (including 10 per cent. correction for growth during grazing). Actually, smaller amounts eaten per head per day were recorded at a few samplings. The sheep, as stated, were small ewe weaners of an average live weight of 89 lb.

As to the "maintenance requirement" of a sheep of given live weight, there is an absence of agreement among the various investigators of the subject. Woodman and Evans (8) record that they assumed that a sheep of 114 lb. live weight would require 1,700 gm. of dry matter per day for maintenance; actually, the daily consumption was only 800 to 1,300 gm. Discussing the amount of starch equivalent (S.E.) required per 100 lb. live weight, for maintenance, they show that 0·9 lb. S.E. per sheep per day was used, and that if this figure was corrected by one-fifth for hays (as maintained by Professor T. B. Wood) the result (1·08 lb. S.E. per sheep per day) falls considerably short of the figure generally accepted (1·26 lb. S.E. per sheep per day). They refer to earlier German investigators who determined 0·74 lb. S.E. per 100 lb. live weight per day as a maintenance ration. Taking all these conflicting results into consideration, our apparently low figure of 7·8 lb. of green herbage per day for a growing sheep of an average live weight of 90 lb. must be taken as fairly accurate, particularly when the high nutrient value of the ration, as shown by the fodder analyses, is taken into account.

Seasonal Variation in Appetite.

This variation is somewhat obscured by the frequent adjustments in the number of sheep carried, but it appears that the sheep ate more in periods of rapid growth. Fig. 2 shows the number of sheep carried throughout the year, and Figs. 2 and 6 show the daily consumption of green herbage per sheep. Consumption reached its highest figures for the year at the spring flush and mid-summer periods, but to determine if there is a definite periodicity of appetite corresponding in general to the periodicity of growth of the pasture would require a much greater number of results.

One other factor of considerable importance in regard to appetite was weather. The depressing effect of cold wet weather on daily consumption is shown by comparison of Figs. 1 and 6 at the September, November, and February–April periods, and heavy rain at the grazing on 9th January, 1932, reduced the amount eaten per head for that day to a very low figure as compared with other samplings at this period. Attempts to establish a correlation between the incidence of rainy days and live weight variations met with varying success, the best correlation being obtained between the "variation in number of rainy days (per rotation period of ten days) from theoretical seasonal curve of rainy days" and "variation in live weight from theoretical curve of live weight increase" for the 2½-acre plot sheep in 1930 ($-0{\cdot}56 \pm 0{\cdot}09$). A correlation co-efficient of —0·34 was obtained between "live

weight gain" and "number of rainy days in ten days previous to weighing."

Other investigators have reported on the adverse effect, on live weight gain of sheep, of high temperatures, and of cold weather on milk production by cows, so it would appear that the general principle with stock is that any sudden major deviation from the general weather conditions at any period has an adverse effect on appetite. This is thought by the writers to be generally more of a temporary nature than otherwise, as we have noted that if the sheep went on to a plot and it rained that day they would graze very little, but that if the rain continued hunger would force them to graze more normally, despite the unpleasant weather conditions. This fact renders the establishment of a correlation of live weight variation (and amount of green herbage consumed per head per day) with weather conditions somewhat abortive. In any case, in view of the importance of seasonal variation in appetite, and other factors, a large number of samplings during a restricted period will be necessary to obtain full information on this point.

Chemical Composition of Herbage.

The difficulties in regard to the collection of the clippings, and their contamination with animal droppings and soil, has been discussed; even after the former were removed by hand-cleaning, it was necessary to compute the fodder analyses on a silica-free basis. Given the fodder analysis of the herbage present before grazing and the herbage remaining after grazing, the chemical composition of the herbage eaten was calculated as shown in Table II.

TABLE II.—SHOWING THE METHOD OF CALCULATION OF THE CHEMICAL COMPOSITION OF THE HERBAGE EATEN.

A. *Fodder Analyses*—(Plot B3, grazed 10th November, 1931).

—	Herbage Before Grazing.	Herbage After Grazing.
	%	%
Moisture as received	13·4	12·2
On dry basis—		
Silica	5·83	4·60
On silica-free dry basis—		
Protein	21·10	18·23
Fibre	23·68	25·04
Ash	8·18	7·56
Nitrogen-free extract + Fat ..	47·04	49·17

B. *Calculation of Fodder Analysis of Herbage Eaten*—(Gram per sample area of 8 square link, mean value).

—	Before Grazing.	After Grazing.	Amount Eaten.	Percentage Composition of Amount Eaten.
	%	%	%	%
Wet weight ..	80·36	53·77		
Moisture	10·76	6·56		
Dry Weight ..	69·60	47·21		
Silica	4·06	2·17		
Silica-free dry weight	65·56	45·04	20·52	
Protein	13·83	8·22	5·61	27·4
Fibre	15·52	11·29	4·23	20·6
Ash	5·37	3·40	1·97	9·6
Nitrogen-free extract + Fat	30·84	22·13	8·71	42·4

In addition to the error of sampling involved, these results do not take into account the growth occurring during grazing, a percentage of which is grazed, but they are in no way misleading as to the relative fodder value of the herbage eaten by the sheep under the varying conditions.

At all times the herbage eaten was of a very high nutritive value, and was always higher in protein and lower in fibre than the herbage before grazing, and that left after grazing. Evidently the leafy portions of high protein content were preferred by the sheep. In Table III. are given the analyses of "leafy" and "stemmy" portions of the herbage sampled from one of the plots in December, 1930, and hand-separated into these classes. Comparison of Figs. 6 and 7 illustrates this continued preference for the leafy portion. There is a negative correlation here, from which we infer that when small amounts were eaten the leafy portion was preferred, and when large amounts were eaten, due to heavy stocking, the stemmy material was also eaten perforce.

TABLE III.—RELATIVE CHEMICAL COMPOSITION OF LEAF AND STEM.

—	Leafy Herbage.	Stemmy Herbage.
	%	%
Crude protein	23·55	11·52
Crude fibre	19·54	29·52
Ash	11·34	9·02
Ether extract	3·64	2·25
Nitrogen-free extract	41·93	47·69

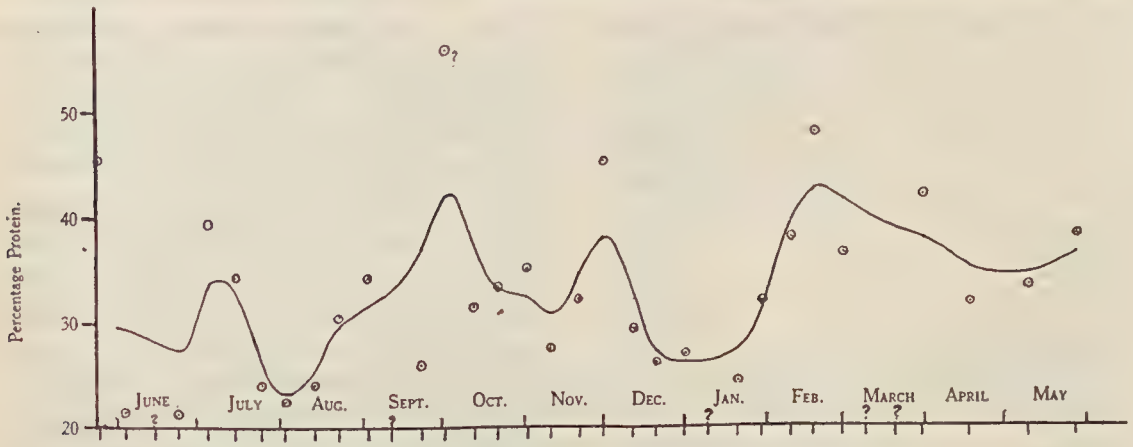

Fig. 7.—Showing the percentage of protein in the herbage eaten.

The results of the chemical analyses are summarized in Table IV. (based on the amount of each constituent eaten at each sampling). The seasonal results differ in some respects from those obtained in mowing trials. In the Frequency of Cutting Test (5) the highest protein values were obtained on the fortnightly cut plots in the autumn period, and in this test a similar result is obtained for herbage eaten in March–April–May. The descending order of protein-richness was roughly autumn, winter, summer, early summer, and spring on the mowing tests, whereas it is autumn, spring and early summer, summer, and winter in this grazing test.

TABLE IV.—RATION EATEN (CALCULATED FROM ANALYSES AND SAMPLINGS OF HERBAGE BEFORE AND AFTER GRAZING). ROTATIONAL GRAZING TRIALS, 1931–32. (BASED ON AMOUNT OF EACH CONSTITUENT EATEN AT EACH SAMPLING.)

Season.	Composition of Ration.			
	Protein.	Fibre.	Ash.	Nitrogen-free Extract + Fat.
	%	%	%	%
June–July–August	27·0	16·4	7·8	48·8
September – October – November	33·2	16·4	8·1	42·3
December – January – February	28·8	18·5	7·7	45·0
March–April–May ..	35·3	15·2	9·7	39·8

The probable explanation is to be found more in the method of harvesting than in the composition of the total herbage produced during those periods of grazing. The high protein percentage of the herbage eaten in spring and early summer, as compared with clippings obtained during that period, may be taken confidently as being due to the comparative neglect of the stemmy portions. The summer herbage occupies the same relative position, but the winter herbage is very low in the order compared with clippings. This is probably due to a close grazing with removal of some accumulated stemmy material. In mowing trials practically only the leafy portion of the herbage is harvested during the winter period, and what is left still offers appreciable grazing to sheep. It has to be borne in mind that these effects of season on the composition of the herbage eaten have been modified by variations in the number of sheep carried.

Botanical Surveys.

The detailed results of the botanical surveys are not given in this report. The aim of the surveys was to determine the changes (if any) resulting from the grazing system, and the preferences (if any) shown by the sheep for any particular species.

Table V., showing the "average palatability" of the various species, has been arrived at by calculating the "percentage eaten of the amount offering" for each species at each survey, and weighting this figure according to the number of sheep grazing at the time. The table shows subterranean clover as the most palatable species, and rye grass as the least palatable, but these conclusions must be modified before general

TABLE V.—AVERAGE PALATABILITY OF SPECIES. ROTATIONAL GRAZING TRIAL, 1931–32.

	Percentage Eaten.
Subterranean clover	55·7
Strawberry clover	45·6
Cocksfoot	42·7
White clover	39·6
Weeds	32·2
Kentucky blue-grass	25·2
Miscellaneous grasses	21·6
Perennial rye grass	13·4
Total clovers	47·3
Weeds	32·2
Total grasses	20·2

application in view of the fact that subterranean clover was a minor element of the herbage, and as such was relatively more eagerly sought after for variety.

The actual amounts of each species eaten by the sheep during the year are shown in Table VI., and it will be seen that rye grass there occupies third position. Strawberry clover is in a high position in both tables, and thereby proves its value in spite of the adverse factor of a high amount offering. The remarks applied to subterranean clover may be applied also to weeds. The clovers are in general more palatable than the grasses.

With regard to botanical changes induced by the system of grazing employed, other factors such as watering methods have played an important part in these changes, and it is impossible to definitely ascribe any particular change to the grazing system. Subterranean clover was one species whose diminution in the pasture may be attributed to more efficient watering methods; Kentucky blue-grass, on the other hand, being sensitive to continued defoliation, has probably been reduced more by the grazing system than by any other factor.

TABLE VI.—AMOUNT OF EACH SPECIES EATEN. ROTATIONAL GRAZING TRIAL, 1931–32.

	(Gm. Dry Matter per 8 sq. lk.)
Strawberry clover	80·47
White clover	58·69
Rye grass	45·92
Cocksfoot	39·35
Subferranean clover	20·43
Kentucky blue-grass	9·37
Miscellaneous grasses	3·61
Weeds	1·96
Total clovers	158·14
Total grasses	98·03
Weeds	1·96

The system of surveys did not permit of any detailed examination of the results, as to discuss periodicity, &c., of species in detail one would need to know the rate of growth of each species during each period between grazings. This would mean botanical survey and sampling of a single plot before and after each grazing. Unfortunately, yield-sampling is so drastic in its action on the sward that to take 37 lots of 60 samples of eight square links each during the year from a ½-acre plot would have a very detrimental effect on the plot. As this investigation was merely subsidiary to the investigation of carrying capacity, it was considered unwise to do anything to the detriment of the latter. The varying appetites of the sheep preclude the possibility of estimation of growth-rates from the results obtained by sampling and surveying adjacent plots.

Summary.

1. The application of a system of yield-sampling and botanical surveys to a trial of rotational grazing is described.

2. The limitations of the method are discussed.

3. The pasture type, and its treatment and performance in regard to live weight increases and carrying capacity, are described.

4. The carrying capacity varied from eleven to twenty sheep per acre during the test, and the live weight increase (the lowest for any year of test) was 563 lb. per acre.

5. The total herbage removed by the sheep was approximately 17½ tons (80 per cent. moisture) per acre.

6. The amount of green herbage eaten per sheep per day averaged about 8 lb., but rose as high as 22 lb. and fell as low as 3½ lb.

7. The influence of season and weather on appetite of sheep is shown.

8. Dropping of lambs just before the commencement of the spring flush is advocated.

9. The herbage eaten by the sheep is shown to be of high nutritive value, and to show a seasonal variation distinct from that shown in mowing trials.

10. Botanical changes induced by the grazing system are discussed, and the palatability of the various species measured for the period.

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Emulsification of Olive Oil in Dipping Solutions for Sultanas.

(Note issued by the Fruit Processing Committee).

OLIVE oil is invariably used in the dipping solutions into which sultanas are immersed prior to drying. Until the last two years, the vine growers made their own emulsions by stirring the olive oil into a weak solution of carbonate of potash. At the present time, stable prepared emulsions, in which the oil globules are very much smaller, have been placed on the market by various proprietary firms. During the 1936 season, the relative merits of prepared stable emulsions, in comparison with "home-made emulsions," were investigated by Mr. E. C. Orton, of the Commonwealth Research Station, Merbein. The results of Mr. Orton's work have recently been presented in an interim report.

Dipping Investigations.

The full range of the investigations cover all phases of dipping, including variations in the quantities of all substances used in the dips, the objective being to obtain evidence regarding the exact functions of olive oil, potash, and caustic soda, in both cold and mixed dips. No alterations in the method of preparing these dips are suggested until further progress has been made in the work outlined above. On the other hand, as the prepared emulsions are now replacing "home-made" emulsions, a note on the results obtained is of immediate interest.

Olive Oil Emulsions.

A disadvantage of home-made emulsions arises at times from "free oil," particularly in the cold dip when first used. Also, the oil is removed from the dip relatively faster than the other ingredients, and needs additions from time to time. These are difficulties completely overcome when the oil is used as a stable emulsion. In large scale trials no additions were found necessary. Identical results were obtained from cheap and expensive brands of olive oil when used as a stable prepared emulsion; whereas, for home-made emulsions, a good quality oil, easily emulsified, is essential. It has been previously established that, within limits, the drying rate becomes faster as the quantity of oil in the cold dip is increased. A similar result was obtained with prepared emulsions. No alteration in the amount of olive oil at present recommended is suggested. Any decrease in the quantity of oil applied to the fruit in a cold dip is definitely dangerous, in that the drying rate may be reduced to the point that handling costs become excessive, particularly if wet weather intervenes.

The present finding in reference to quality, is that the fine stable emulsions give, in the cold dip, slightly better results. The difference in mixed dips is not nearly so noticeable.

Recommendations.

1. When prepared stable emulsions are used in the dips for sultanas, the quantity of actual oil should be similar to the quantity at present recommended in standard formulae for cold and mixed dips.

2. The quantity of oil in the emulsion must be known to the user, in order that correct quantities can be incorporated in the dips.

Orchard and Garden Notes

By Edward E. Pescott, F.L.S.

The Flower Garden.

THERE should be excellent dahlia growth this season, owing to the frequent rains. Growers should now prepare for the summer and autumn winds by supporting dahlias, and indeed all other brittle plants, with strong stakes. Stakes should be placed in the ground at the same time as the tubers; where this has not been done care should be taken that they are not driven through the tubers.

The plants will benefit from a good manurial top-dressing, but it must not be applied if the buds are beginning to show colour. Cool top-dressing in the shape of grass, leaf mould, or similar material, may be given at any time.

All seeds for autumn and winter flowering plants should now be sown. It is preferable, except in the case of very tender plants, to sow the seeds outside in the open. A nice sandy patch of soil should be selected, and some well broken leaf mould worked into it. The seeds should be lightly scattered in the top layer; sweet pea seed, however, may go down an inch or two.

After the sowing the bed should be lightly covered with well broken old dead leaves, loose grass, fibre, or some such shade-giving material which will admit air freely. On hot or windy days, the bed may be covered with hessian, or paper frames, to protect the germinating seed.

The Kitchen Garden.

Seeds of the cabbage family, and of root crops, should now be sown for late season crops. Some may be sown in the rows and some in seed-beds for transplanting. The seed-beds should be of friable soil, with both sand and leaf mould in their composition.

All seeds, except large ones, should be sown very shallow, and lightly covered with loose well-broken old leaves. It may be necessary to replace this covering surface if it be blown away, or at all disturbed. Such protection is essential if a good germination percentage is to result.

A decorative dahlia.

No manure should be used in the seed-beds. In fact, for cabbage, cauliflower, sprouts, kale, and similar plants, the soil should be of a very poor quality, as hard and semi-starved seedlings give better crops than those that are "leggy" and overgrown.

The Orchard.

Special attention must be paid at the present time to the prevention of an infection of the late brood of codling moth which has about reached its peak period. Either a lead or an oil spray should be given to cover the fruit, which should be kept so covered until the time of picking.

White oil is definitely an ovicide and it is essential that the time of application coincide with the egg-laying. Though it is comparatively easy to see the eggs on the fruit, it is important that lures should be hung in the trees so that the flight of the the moths may be noted. It is also necessary that the prevalence and condition of the larvæ and pupæ in the bands be known.

It has been estimated that the effective ovicidal period of white oil sprays does not exceed ten days.

Where bag or hessian bands are used instead of the chemical ones, they should be examined thoroughly every week, and the larvæ killed. Any difficulty experienced in fermenting the vinegar or molasses in the lures may be overcome by placing a small piece of bluestone in the liquid.

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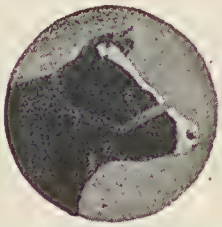

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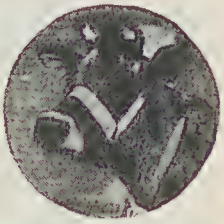

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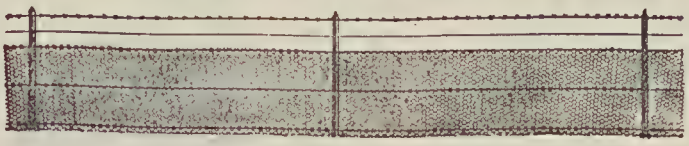

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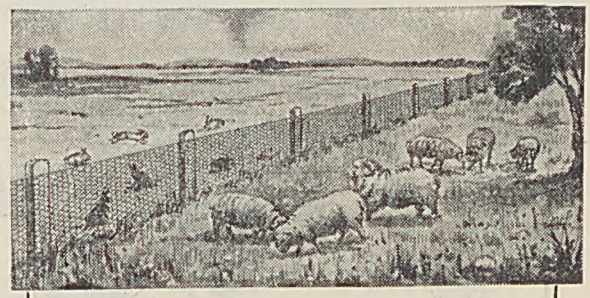

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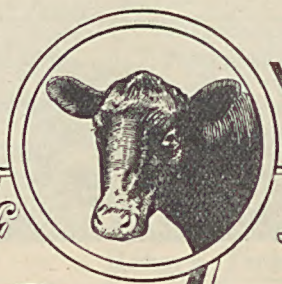

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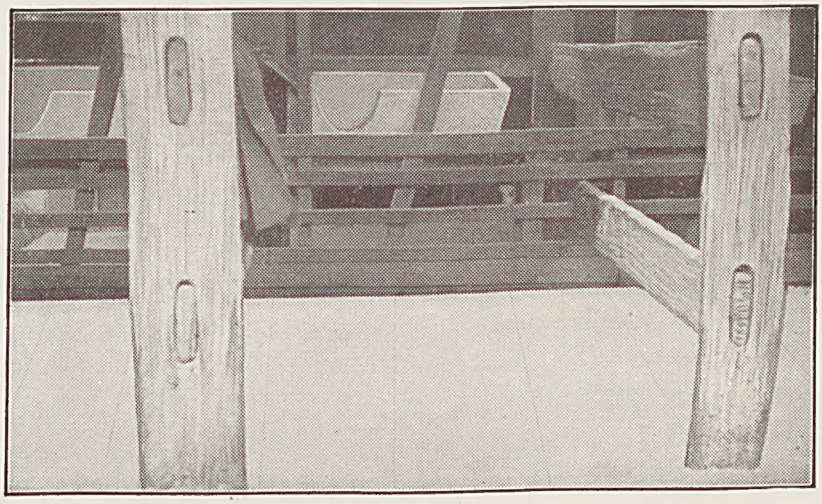

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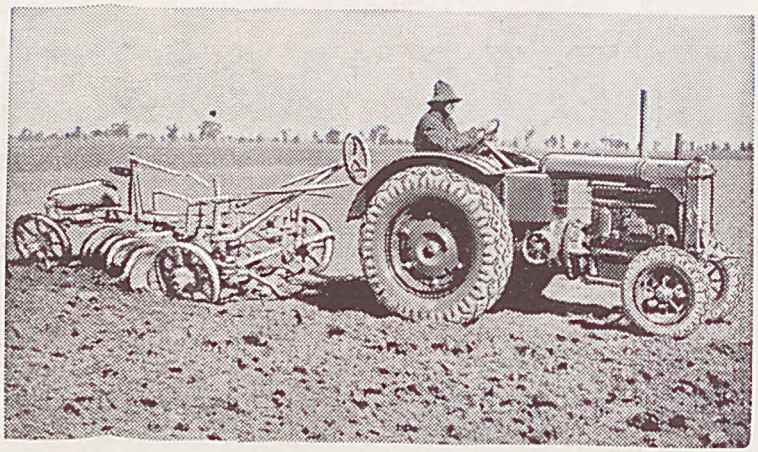

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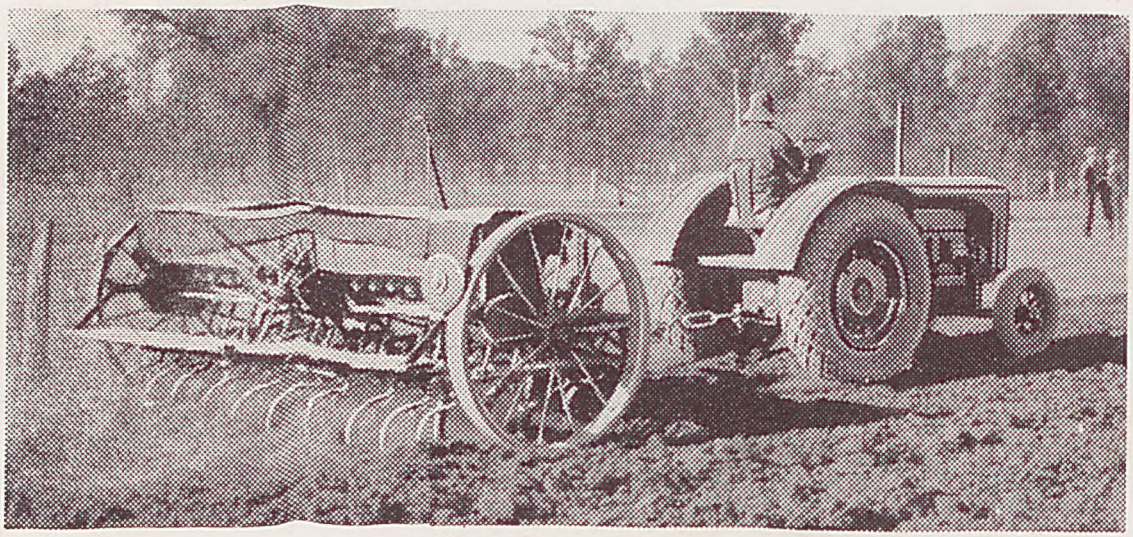

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